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A High-Speed Color Negative Film

By MERLE L. DUNDON and DAAN M. ZWICK

The new 35mm camera film, Eastman Color Negative Film, Type 5250, has been designed to replace Eastman Color Negative Film, Type 5248. The new film has a similar structure but is twice as fast as the older film. This permits exposures under more difficult lighting conditions, or with greater depth of field or more economy in set lighting. Processing and printing procedures are similar to those for Type 5248. Minor differences in the characteristics of the two films which may affect picture quality are discussed.

At the spring meeting of the Society in Chicago in April, 1950, the first Eastman Color Negative Film, Type 5247, and Eastman Color Print Film, Type 5381, for motion-picture use were described by Hanson.[1] In line with color camera materials previously used by the industry, the negative was balanced for daylight illumination or high-intensity carbon arcs. One of the first uses of these films was to photograph the Canadian tour of Princess Elizabeth and Prince Philip. This simple negative-positive system was presented with the realization that duplicating materials would be needed in order to meet professional motion-picture requirements.

As an initial step in accomplishing this goal, Eastman Panchromatic Separation Film, Type 5216, and Color Internegative Film, Type 5243, were introduced. The use of these materials for duplicating operations was described in detail by Anderson, Groet, Horton and Zwick in October, 1951.[2] Their paper outlined the procedures for preparation of black-and-white separation positives on Type 5216 Film from the original color negative and registration printing of these positives onto Type 5243 Film to give a color duplicate negative. With this development, at least one solution to the problem of incorporating special effects was found.

To keep abreast of changes in studio-lighting practice, a new color negative material, Eastman Color Negative Film, Type 5248, balanced for tungsten illumination, was developed. One of the first uses of this film was at the Coronation of Queen Elizabeth. Paralleling this advance, further improvements were made with respect to the color internegative and print materials. In April, 1953, Hanson and Kisner[3] presented an extensive paper describing the improved Eastman Color Negative Film, Type 5248; Color Internegative Film, Type 5245; and Color Print Films, Types 5382 (35mm) and 7382 (16mm). Details were also given pertaining to the formulas, printing and processing steps, and control procedures used with the various films. With some minor differences, the specifications outlined in that paper are the same as those in use at the present time.

A further improvement to the system was brought about by the introduction of Eastman Panchromatic Separation Film, Type 5235, as a replacement for Type 5216 Film. The new material provided better development characteristics and eliminated the residual overall dye stain in the processed separations.

An all-color duplicating system, in addition to the method using separation positives, seemed desirable, especially where negatives differing in size from the camera original were required, for example, when the camera original negative was made on 65mm film and release prints were to be made on 35mm film. In October, 1956, Bello, Groet, Hanson, Osborne and Zwick[4] described a new color film, Eastman Color Intermediate Film, Types 5253 (35mm) and 7253 (16mm), for this application. The film was designed in such a manner that it could be used for making both a color master positive and a color duplicate negative. While this all-color duplicating system provided greater simplification of the operations, it did not allow for the protection of the original or intermediates against fading or other damage. When such protection is desired, the preparation of separation positives is still considered necessary.

Research and development work has continued with the aim of improving these products. The present paper is concerned primarily with the characteristics of the new color negative camera film of higher speed, and how they compare with those of the currently used Type 5248. Laboratory procedures will not be covered in detail since they are the same[3] as those in use for Type 5248.

The Need for More Speed

Manufacturers of photographic products are keenly aware of the desire for films having both higher speed and lower granularity. Through experience, however, they are also aware that simultaneous improvements in both of these properties do not come about easily, and it is sometimes necessary to accept little or no improvement in one property to obtain a substantial gain in the other. With the advent of wide-screen pictures, the use of larger sets required even more light than before (Fig. 1), and it was evident that a faster color negative film would be important. In addition, the use of larger-size negative films required longer-focal-length lenses and therefore smaller apertures for the same depth of field, making a faster color negative film still more desirable. It was therefore decided in the early stages of this work that a higher-speed camera film would be more useful than one having lower granularity. Work has continued with this aim in view, and the new high-speed color negative film described in this paper is the result of that effort.

Structure and Composition

The new product is designated as Eastman Color Negative Film, Type 5250. It has twice the speed of the earlier Type 5248 Film and has only minor differences in other characteristics, as will be noted. An important feature of the new material is that it is completely

Presented on May 5, 1959, at the Society's Convention in Miami Beach by Merle L. Dundon (who read the paper) and Daan M. Zwick, Eastman Kodak Co., Film Emulsion Div. and Research Labs., Kodak Park Works, Bldg. 26, Rochester 4, N.Y.
(This paper was received on August 19, 1959.)

Fig. 1. A large set used in modern motion-picture production showing part of the extensive lighting required for color motion pictures. (Courtesy Walt Disney Productions)

compatible with existing practices involving Eastman Color Films.

The structure of the new Type 5250 Film is fundamentally the same as that of Type 5248 Film, as shown by the schematic cross section of Fig. 2. Adjacent to the safety support is a blue- and red-sensitive emulsion layer. Above this is a thin gelatin interlayer and then a blue- and green-sensitive layer. Next is a yellow-filter layer to prevent blue light from reaching the lower emulsion layers. At the top is a blue-sensitive emulsion layer. The reverse side of the support contains the same jet antihalation backing used on other Eastman Color Films.

The emulsion layers each contain the appropriate dye-forming couplers which serve to produce the color images on development. For the cyan and magenta image layers, colored couplers are employed. The unused portions of these couplers remaining in the film after processing provide masks to correct for the unwanted absorption of the process dyes and thus improve color reproduction. These couplers are similar to those used in the earlier Type 5247 and Type 5248 materials and have been described in a previous paper.[1] A new, yellow-dye-forming coupler in the top layer of the film has been used with the purpose of improving still further the color reproduction of the Eastman Color system.

A comparison, shown in Fig. 3, of the spectral density curves of the process dyes at a fixed density level for both Type 5250 and Type 5248 Films shows in a quantitative way the differences between the two materials. It will be noted that the new, yellow-forming coupler produces an image dye having less absorption for green light than did the corresponding dye for Type 5248 Film. The improvements in color reproduction which result from this change will be discussed later.

Exposure

It was stated earlier that the essential feature of the new Eastman Color Negative Film, Type 5250, is that it is one full stop faster than Type 5248. The one-stop speed increase can often be used to increase depth of field by using a one-stop smaller diaphragm. The net result of such practice will be the appearance of overall improved screen definition. More of the objects on the set will appear in sharper focus, giving the same sort of result that might have been obtained with a film of improved sharpness. Of course, in many cases the increased speed may be used to reduce the required amount of light, with attendant advantages in reduced costs or increased comfort for the actors. A third use to which the increased speed may be put is that of photographing subjects which were previously considered inadequately lighted.

The basic light source with which the film can be used unfiltered is the currently used studio tungsten lamp of approximately 3200 K color temperature. Photography under daylight conditions or with carbon-arc lighting is possible with the same conversion filters which have been recommended for Type 5248 Film.[3] Exposure index values are given as 50 for the 3200 K tungsten light and 32 for daylight illumination when a Kodak Wratten Filter No. 85 is used. These compare, respectively, with values of 25 and 16 for Type 5248 Film. Recommended lighting values, filter conditions and exposure indexes are given in Table I.

For control purposes, the same sensitometric exposures which have been used for Type 5248 Film should apply to Type 5250, with adjustments for the two-times speed increase where necessary.

Processing

It was indicated that the new film is completely compatible with existing Eastman color film practices. With respect to processing, this means that recommended formulas, times, temperatures and mechanical conditions are the same for this film as for Type 5248.

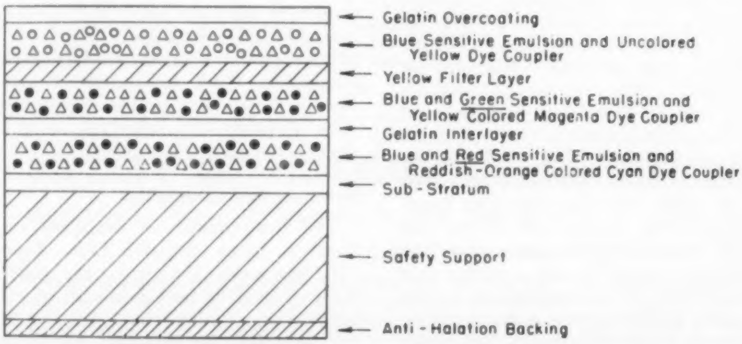

Fig. 2. Schematic cross section of Eastman Color Negative Film, Type 5250.

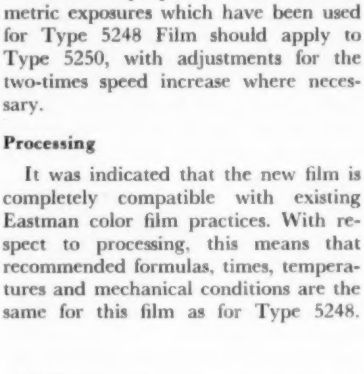

Fig. 3. Spectral density curves for the individual dyes of Eastman Color Negative Films, Type 5248 and Type 5250: —— Type 5248; – – – Type 5250.

Table I. Exposure Data.

Film	Balanced for °K	Basic exposure	Exposure index
Type 5248	3200	200 ft-c $f/2.0$ 1/50 sec	25
Type 5250	3200	100 ft-c $f/2.0$ 1/50 sec	50

Film	Filter for daylight	Exposure index
Type 5248	Kodak Wratten No. 85	16
Type 5250	Kodak Wratten No. 85	32

Laboratories following these recommended procedures[3] should be able to obtain well-processed negatives on either material interchangeably. However, it should be noted that because the two films are not identical, departures from the recommended processing conditions may have different photographic and physical effects on each film.

The handling and storage of raw stock and processed Eastman Color Negative, Type 5250, require the same precautions as previously stated for Type 5248 Film.[3]

Discussion of Photographic Properties

In the preceding general discussion, reference was made to certain differences between Type 5248 and Type 5250 color negatives. These differences will now be examined in more detail and their significance to the laboratory technician or to the quality of the final print will be discussed.

The one-stop speed difference has been covered adequately, and it should not be necessary to reiterate its significance in such aspects as lighting economy, depth of field or just plain convenience.

In early work on this film, both physical measurements and motion-picture tests showed that the speed increase had not resulted in increased graininess, and no significant difference in image sharpness between Type 5248 and Type 5250 was detected or expected. Further practical tests under a variety of conditions at different studios and laboratories, while confirming the early impressions, have resulted in some specific comments that the pictures look a little sharper and that the grain is slightly more evident or different. In general, we do not believe that the difference in image sharpness or graininess is sufficient to be of practical significance. However, when the new negative is printed with highly specular light, prints show increased granularity, because of the rougher surface of Type 5250 negative. Highly specular light is affected by a rough surface and reproduces it in the print as a granular image. This increase in granularity is avoided by the use of diffuse light printing, or by contact printing. If it is necessary for other reasons to use extremely specular light in optical printing, the increase in granularity may be avoided by use of liquid gate printing.[5]

Spectral Sensitivity

As shown in Fig. 4, the new film is different in some respects from Type 5248 Film in spectral sensitivity, that is, in response to light of different colors. This difference, in general, is small, but in a few particular instances it may have a noticeable photographic effect. The shift in green-sensitivity, for example, could cause certain fabrics with cyan or orange dyes which are highly selective in that spectral region to be reproduced with more or less magenta dye on one film than on another. It should be emphasized that this is not a case of one film being better than the other in this respect; rather one film is only different from the other. The main significance is that it indicates a continued need for make-up and wardrobe tests by critical users.

Spectral Absorption

It was mentioned previously that the new film has a different dye system (Fig. 3), which should result in small improvements in color reproduction. Another effect of this change in dyes may be noted in some operations where printers are used. The new dyes combine to form a more selective neutral color, as shown in Fig. 5. Under certain special conditions of narrow-band additive printing, use of a green filter of a particular bandpass may result in a mismatch in contrast when printing from Type 5250 which did not exist when printing from Type 5248. Should this condition occur, it can be corrected by proper choice of green printing filter. Although specific instructions on this count cannot be given, such a change might be to a slightly wider bandpass filter or a filter shifted in peak transmission of the order of 10 mμ to either the shorter or longer wavelength.

Examination of the sensitometric curve of a neutral exposure scale of Type 5250 Film compared with that of Type 5248 (Fig. 6) shows that the new film has relatively less blue density and slsghtly more green and red density. This means first of all that a piece of processed Type 5250 negative held in the hand will appear less yellow than the Type 5248 negative. Of more practical importance, the new negative will print at a slightly different printer balance than was generally used for the old negative. This change is well within the color-timing range of a motion-picture printer. In typical additive and subtractive printing operations, normally exposed Type 5250 negatives required less than 0.10 log E more green and red light relative to blue light, compared with Type 5248 negatives. It should be noted that most of the difference in negative density comes from an adjustment of relative speeds, the need for which was indicated by a survey of studio exposure conditions. The new film represents an improvement in this respect.

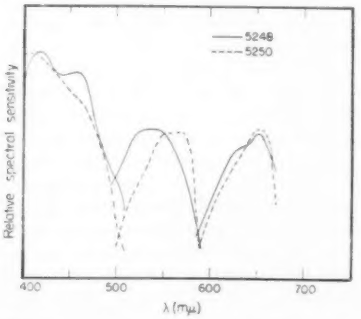

Fig. 4. Relative spectral sensitivity curves of Eastman Color Negative Films, Type 5248 and Type 5250: —— Type 5248; - - - Type 5250.

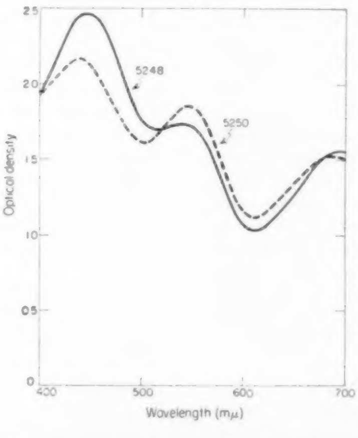

Fig. 5. Spectral density curves for a neutral image of Eastman Color Negative Films, Type 5248 and Type 5250.

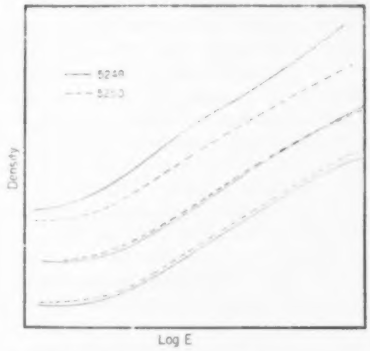

Fig. 6. Density-log exposure curves for Eastman Color Negative Films, Type 5248 and Type 5250: —— Type 5248; - - - Type 5250. The exposure given the Type 5250 negative is one-half that given the Type 5248 negative.

Summary

A new, 35mm camera film, Eastman Color Negative Film, Type 5250, has been designed to replace Eastman Color Negative Film, Type 5248. Similarities and differences between this film and Type 5248 have been described. Practical advantages of the speed increase have been pointed out and possible changes in picture quality or laboratory handling conditions which may result from differences that exist between the two negative materials have been discussed.

Note: At the conclusion of the paper, a demonstration film was projected showing Eastman Color Print Film prints made from Type 5248 and Type 5250 negatives, alternately with the same subjects. Some of the scenes demonstrated the general similarity of photographic quality, including graininess, sharpness, and color reproduction. In other scenes, deliberate changes were made to point up the increase in speed and the benefits which result from it.

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2. C. Anderson, N. H. Groet, C. H. Horton and D. Zwick, "An intermediate positive-internegative system for color motion picture photography," *Jour. SMPTE, 60:* 217–225, Mar. 1953.
3. W. T. Hanson, Jr., and W. I. Kisner, "Improved color films for color motion picture production," *Jour. SMPTE, 61:* 667–701, Dec. 1953.
4. H. J. Bello, Jr., N. H. Groet, W. T. Hanson, Jr., C. E. Osborne and D. M. Zwick, "A new color intermediate positive-intermediate negative film system for color motion-picture photography," *Jour. SMPTE, 66:* 205–209, Apr. 1957.
5. J. R. Turner, D. E. Grant and H. E. Breton, "Printing motion-picture films immersed in a liquid. II. Optical printing," *Jour. SMPTE, 66:* 607–615, Oct. 1957.

Discussion

John Breen (General Film Laboratory): Will this increase in speed in the Eastman Color Negative have any effect on the speed of processing the Eastman Color Negative?

Dr. Dundon: The process is exactly like that for Type 5248 and the only difference is in the increased speed for exposure. The handling is just the same and they can be processed together.

Lt. Avrum M. Fine (White Sands Missile Range): Is this film stock available now in warehouses throughout the country?

Dr. Dundon: Our sales department would know more about that. It will be introduced gradually and I think some will be available soon.

Lt. Fine: Well, the reason I asked this question is that we could have used this film for experimental purposes in a project, if we had obtained some.

Mr. Hyndman: I don't know why you should put me on the spot. We'll be distributing samples within the next ten days. Undoubtedly you too will get samples, and we expect it to be commercially available sometime in July. Warehouse stock is in limited quantity. We can't change over completely, but we will have a limited supply available.

Lt. Fine: Will there be any difference in cost?

Mr. Hyndman: No, the price will be the same.

Dr. C. W. Bemiss (RCA Missile Test Project, Patrick Air Force Base, Fla.): It would be desirable to have qualities included in this new film which would permit processing and drying at higher temperatures. Thus, it would be possible to reduce operational costs by an increase in the production capacity of existing installations. Is this new film amenable to accelerated processing or may we expect improvements in this direction in the near future?

Dr. Dundon: With this particular film, I don't think you can do that. All we have done in this case is to make it exactly compatible with Type 5248 and I wouldn't want to predict that it could be processed under any higher-temperature conditions than Type 5248. We frequently have such requests, and we cannot say what might be accomplished in the future, but there are limitations with this type of film and process for higher-temperature processing.

An Engineering Approach to Television Film

By L. J. MURCH, HAROLD WRIGHT and RODGER J. ROSS

INTRODUCTION

In a paper* presented at a meeting of the Canadian Section of the Society in September 1957, and subsequently published in the *Journal*, it was stated that in the production of television film the mere adaptation of conventional motion-picture techniques has failed to produce the desired results. An entirely different approach to the problem was proposed — namely, that it is necessary to commence with the telecine reproducer and work backwards through the film process to the taking camera, in order to produce film images which will generate predictable video waveforms.

It was recognized then that a number of serious obstacles stood in the way of the practical application of such a scheme, particularly the lack of industry standardization in areas such as telecine set-up, film exposure techniques and film processing.

The reproduction of film material by means of a television system has always been extremely variable in tone or gray-scale quality. Attempts to improve this situation have usually failed because of the large number of variables involved between the original scene and the final viewing device. There are very few situations where one person or group of persons has control of all of these variables.

The largest differences in quality of film generally have been observed between film exposed under different conditions and processed by different laboratories, etc.

There is usually a significant difference also in the quality of the reproduction of the same film on different occasions even when reproduced on each occasion with the same equipment.

The broadcaster has been unable to establish a standard reproducing characteristic because his equipment has had to retain sufficient flexibility to handle the wide variations in density encountered in film presented for television reproduction. For example one conclusion reached after a study of television film was that telecine equipment should be able to reproduce film with a highlight transmission ranging from 80% to 3%, or with minimum densities varying from 0.10 to 1.52.

The producer of the film, therefore, not having available telecine equipment with a fixed reproducing characteristic has had to produce his film for a satisfactory subjective result when viewed by direct projection. It is unfortunate that so many people believe that all film suitable for direct viewing should also be suitable for telecine reproduction.

When the quality of film is being judged subjectively by direct projection, the brightness distribution on the screen is determined only by the density of the film in conjunction with the intensity of the projector lamp and the reflectance of the screen. The brightness of the television screen, on the other hand, is determined by the output voltage from the telecine equipment; hence the density distribution of the film must be such as to produce the correct voltages from the telecine equipment in order to produce a satisfactory subjective result on the television screen.

If the particular density distribution required to produce these output voltages happens to produce a good subjective picture when viewed directly, this is of no consequence whatever, since the only purpose of the film is to store information which will produce the correct voltages from the telecine equipment.

Apart from the convenience of using standard film equipment, there is no reason why film produced for television should not be of such a form as to be completely unrecognizable by direct viewing if this were found to enhance the broadcast quality via telecine equipment. Such a system has not been developed however. The fact that the images on film have a recognizable form has delayed by several years the progress of television film quality since it has led to complete misunderstanding of the requirements of the television system.

It was thought necessary to make a study of the telecine characteristic and to decide on the optimum adjustment of each variable, taking into consideration the film characteristic and aiming for a linear overall transfer. It was thought also that once the optimum adjustment of the telecine equipment was decided upon, the transfer characteristic could be calculated and used to construct test material for maintaining this adjustment. The standard characteristic could then be used (a) to evaluate the suitability of film presently produced for television, and (b) to calculate the correct exposure and processing for television film to meet the standard reproducing characteristic.

If the principle is accepted that the production of television film footage must be based on the accurate control of density formation in the film, then the concept of significant image areas becomes obsolete and the subjective adjustment of printer exposure level must be abandoned. With a constant-density film system, factors formerly of little consequence become critical. Accurate measuring equipment and techniques and the standardization of sensitometers, densitometers, printers and processing is implied. A high degree of camera exposure accuracy is required. Integrating exposure meters working against exposure indices will not be good enough, because they will produce widely different densities and density ranges in the negative for the same meter reading, depending on the ratio and area of highlights and shadows in the scene.

The tolerances normally allowed in conventional motion-picture practice are much too wide for successful application of the constant-density principle, because adequate quality control from a motion-picture industry standpoint does not imply accurate control of densities. This is particularly true of the film processing operation, in which adjustments are normally made to improve subjective appearance of picture images. In the application of the constant-density principle, image formation in processing must be maintained constant within specified tolerance limits and every effort must be made to ensure that the printer exposure level remains constant.

With a film system set up in this manner, it becomes possible by the use of a spot photometer to measure and adjust the luminance of selected scene elements, with the object of generating a video signal in the telecine reproducing equipment which will have predictable voltage amplitudes. Essential television peak-white and peak-black conditions may be established in the film at the time the negative is being exposed in the camera, and areas of particular interest such as faces may be located in the picture gray scale in any desired relation to black and white end points by measurement and calculation on the set.

The three papers which follow describe the results of detailed investigations which have been undertaken with the object of formulating specific proposals for industry standardization in regard to telecine reproduction, film exposure and processing.

* R. J. Ross, "Film in television," *Jour. SMPTE, 67:* 374–378, June 1958.

Part I: Standardized Gray-Scale Characteristic for Vidicon Telecine

By L. J. MURCH

Factors which influence the gray-scale characteristics of a vidicon telecine chain are investigated and a standard characteristic is developed by deciding upon the optimum adjustment of each of these factors. Test material is developed to set up and maintain this standard characteristic which, subseqently, is used for evaluating the suitability of film material for television reproduction

UNTIL the introduction of the vidicon[1] it was not possible to establish accurately the transfer characteristic of telecine equipment since previous camera tubes used for telecine such as the image orthicon and the iconoscope were affected considerably by electron redistribution. The transfer characteristic was hence dependent on both the average total transmission of the film and the relative sizes of areas of different transmissions. The vidicon is relatively free from such defects. The optimum transfer characteristic for unmodified commercially available vidicon telecine equipment has been established and a provisional standard has been adopted by the Canadian Broadcasting Corp.

A stairstep slide has been designed with ten steps calculated to produce equal increments of output voltage from the standardized telecine equipment. This particular design of test slide was chosen in order that the ten steps at the output of the telecine equipment would coincide with the ruled lines on the standard IRE waveform monitor graticule. Any deviations from the standard characteristic may thus be readily observed.

Since the transfer characteristic of a TV picture tube is approximately complementary to that of the eye the ten steps when viewed on a picture monitor will be fairly evenly distributed in eye sensation, step 1 being situated at peak white, step 10 being situated at subjective black and the remaining eight steps evenly distributed between. The densities of these ten steps may therefore also be used as a guide in establishing the correct exposure and processing for television film material.

The telecine chain may be split into three main sections, optical, photo-electric and electrical as represented by the simplified diagram shown in Fig. 1.

Optical Section

(1) *Film Density Range*

The first factor which should be considered in determining the optimum adjustment of the telecine equipment is the density range of the film material which it is required to reproduce. The telecine transfer characteristic changes appreciably as adjustments are made to accommodate different film density ranges.

Film used by the CBC for telecine is restricted to 16mm motion-picture film and 2 × 2 slides. The 16mm motion-picture film material is produced by four different methods: (1) TV film recording of TV studio productions; (2) live action shooting specifically for television; (3) shooting of graphics, animation material etc.; and (4) special printing of film originally produced for the theater. Most of the 2 × 2 slides are produced from graphics but occasional use is made of live scenes, normally in combination with graphic material. There is considerable advantage in maintaining the same telecine reproducing characteristic for all types of film since many programs are made up by a combination of film of several different types.

For example, a television station may be supplied with a TV film recording of a production from a live TV studio which contains film types (3) and (4) above as part of the production and film of type (2) above for the commercials while the station itself will insert slides for local promotions and commercials. Although the original TV film recording of such a program includes the film inserts these are removed and replaced with original prints before being supplied to the broadcaster to avoid any unecessary additional degradation. All of this film may have to be reproduced on the same telecine equipment with no pause between film of different types.

The optimum density range which has been established in the CBC for TV film recording is 0.25 minimum to 1.85 maximum. Evaluation of a considerable quantity of film presently being received for broadcast has revealed that most film generally considered to be of good quality also comes very close to this density range. Subsequent calculation and experiment has proved that the same range is applicable to live film shooting while maintaining an overall transfer close to unity. It has therefore been adopted as the provisional standard for all TV film material.

It must be emphasized that the densities specified are absolute minimum and absolute maximum as shown in Fig. 2. They are not the densities of areas in which it is required to reproduce

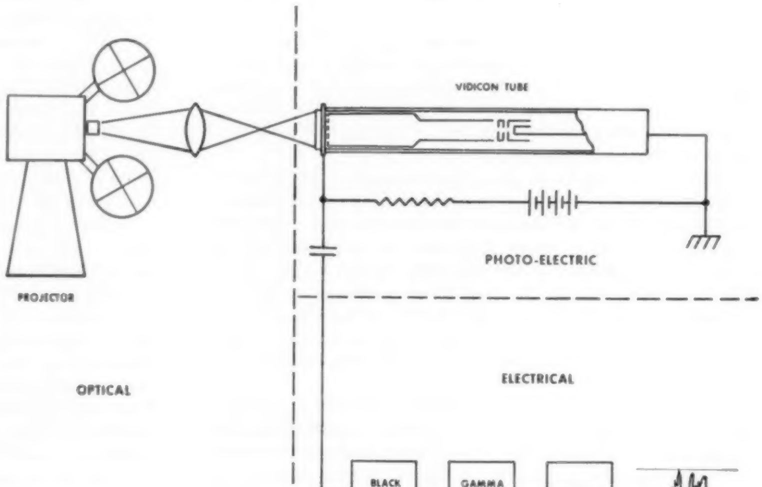


Fig. 1. Simplified diagram of the three main sections of a vidicon telecine chain.

Presented on May 7, 1959 at the Society's Convention in Miami Beach by L. J. Murch, Canadian Broadcasting Corp., 354 Jarvis St., Toronto, Ont.
(This paper was received on June 15, 1959.)

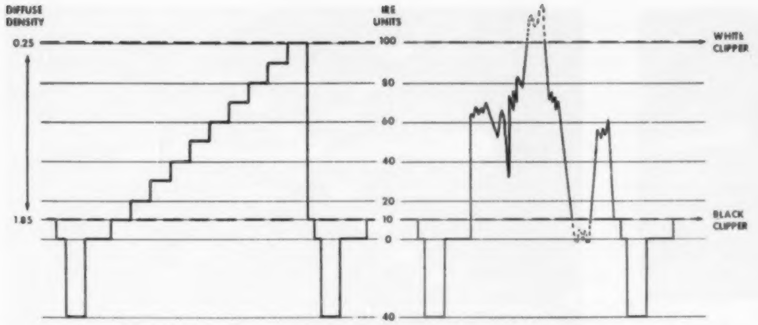


Fig. 2. Waveforms of a single line of the output of a vidicon telecine chain when reproducing (a) the stairstep test slide and (b) film material with a minimum density less than 0.25 and a maximum density greater than 1.85.

detail.[2] When the telecine equipment is adjusted to reproduce this range then any portion of a scene on the film which has a density less than 0.25 is clipped, i.e. it is reproduced at the same level as if it were 0.25 density.

This is done by apparatus preceding the television transmitter in order to prevent interference with the inter-carrier reception of the accompanying sound signal. Similarly, any portion of a scene on the film which has a density greater than 1.85 is clipped to avoid interference with the television synchronizing signal. The densities of 0.25 and 1.85 represent, therefore, television white level and television black level respectively and are the absolute extremes of the reproducible range when the telecine equipment is adjusted for the standard reproducing characteristic.

(2) *Projection System*

Film densities are commonly measured with a diffuse densitometer as recommended by ASA standards. The transmission of light through film in a normal telecine projector-multiplexer system is usually more in accordance with the specular density of the film. This is brought about by the use of collimated light sources in film projectors for greater efficiency.

Measurements have been taken by an EIA (formerly RETMA) subcommittee[3] to establish the relationship between the diffuse transmission of film and the specular transmission in a typical telecine projector-multiplexer system. These measurements are indicated in Fig. 3. The effect of this characteristic is the equivalent of increasing the gamma of the telecine equipment by a factor of 1.48.

The flare in the projector-multiplexer system of the telecine equipment when projecting the stairstep test slide has been measured as approximately 2%. This causes compression of the lower steps as shown in Fig. 3.

Emphasis must be placed on regular cleaning of the optical components in order to maintain the flare at the lowest possible level.

In order to make a proper evaluation of film density with the vidicon telecine equipment it is important to reduce the inherent shading in the film and slide projectors to as low a value as possible. Otherwise a false evaluation can readily be made. For example, if the light level from a film projector were lower on the left side of the picture than on the right then it would appear that the density of parts of the scene on the left were higher than those on the right. In practice, attempts are made to reduce the shading to a value which does not produce more than 10 IRE units difference in video output over the essential area of the whole raster. Before attempting to reduce the shading in the film and slide projectors it is important to ensure that the camera tube is first aligned for minimum shading.

Photoelectric Section

The gamma of the vidicon tube is not affected by the signal electrode voltage providing that each time this voltage is changed the light level is also changed to maintain the signal current at the same value. The manufacturer's recommendation[4] is followed for establishing the signal electrode voltage at the value which produces a dark current of 0.005 μa. This is the minimum sensitivity mode of operation which also reduces the lag and flare to a minimum.

For a particular signal electrode voltage the gamma of the vidicon tube is reduced as the light level and consequently the signal current is increased. The highest signal current is limited by the required corresponding increase in beam current. The maximum beam current is limited by spot size.

It is found that a highlight current of

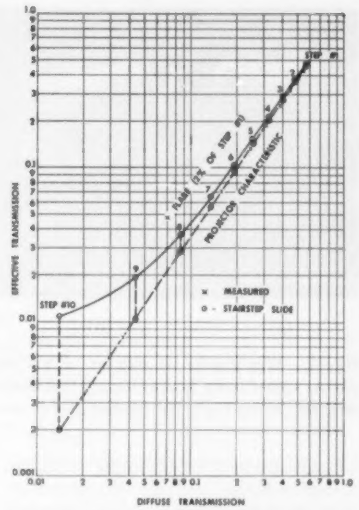


Fig. 3. Optical characteristic of a telecine projector-multiplexer showing (a) effect of specular projector characteristic and (b) effect of the addition of 2% flare.

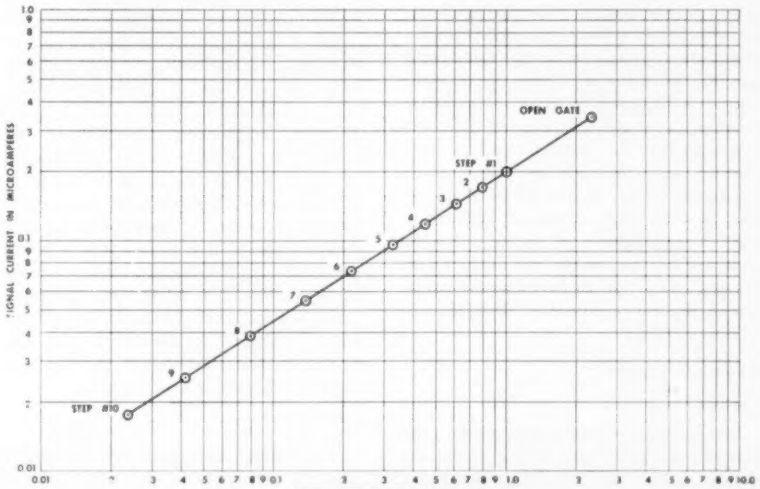
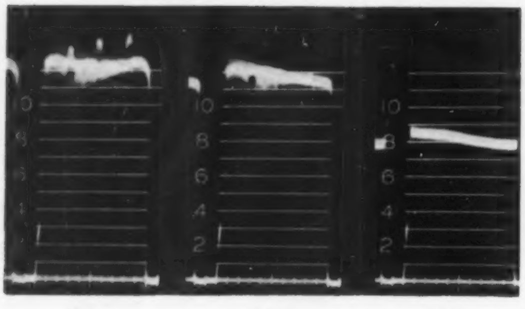


Fig. 4. Graph of vidicon output current/input light level showing current produced by each of the ten steps of the stairstep test slide and open projector gate.



(a) (b) (c)

Fig. 5. Waveforms at output of vidicon telecine chain when reproducing beam current test film with beam settings that are (a) too high, (b) correct and (c) too low.

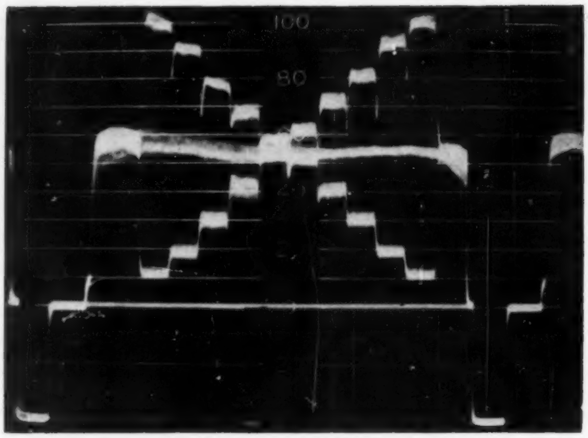


Fig. 6. Output waveform from vidicon telecine chain when reproducing calibrated stairstep test slide.

0.2 μa is optimum for obtaining maximum output without sacrifice of resolution. This highlight current may be obtained by adjusting the light level from all film and slide projectors with open gate to produce a signal current of 0.35 μa. Subsequently film with a density of 0.25 in these projectors will produce a signal current of 0.2 μa as shown in Fig. 4. The manufacturers of the vidicon tube specify[4] that the gamma has a relatively constant value of 0.65 over a range of light levels producing signal currents between 0.2 μa and 0.02 μa. The ten steps of the stairstep slide produce currents between 0.2 μa and 0.018 μa and the gamma is found to be constant over this range.

To preserve resolution the beam current should not be operated much higher than the value required to produce the highlight signal current of 0.2 μa. To establish this adjustment a test device is used. This has been manufactured in both a 2 × 2 slide and a 16mm version and consists of three small windows of base density surrounded by a background with a density of 0.1. This film is projected and the beam current is reduced until the windows are reproduced at the same level as the background. This adjustment allows a margin of additional beam current to avoid clipping of the output signal if the setting were to drift slightly and also allows films to be evaluated with minimum densities as low as 0.1. The waveforms shown in Fig. 5 correspond to beam currents that are (a) too high, (b) correct and (c) too low. The three pulses are produced by the windows of base density in the test film.

Electrical Section

(1) Black Clipper

A steady light bias is produced on the face of the camera tube by the maximum density of the film and by optical flare. This light provides no useful information and has therefore to be subtracted from the light representing the useful signal. As it is not possible in the present state of the art to subtract light the alternative process is used of subtracting the voltage from the camera tube caused by this light bias from the useful signal voltage. This is performed by the black clipper circuit.

(2) Gamma Correction

The overall gamma required for a TV film system from original scene to TV picture tube must originally be determined on a subjective basis although once determined it is important that the subjective aspect be removed and the gamma maintained objectively.

Using the procedures outlined in the accompanying papers by Wright and Ross for exposing and processing film an electrical gamma correction of 0.5 is necessary to produce an overall gamma of unity. Although the telecine equipment presently used has available gamma correction of this order[5] it is found to be undesirable to use such a large amount of correction since the signal-to-noise ratio in the black region of the output signal becomes objectionably poor and it also becomes very difficult to maintain a stable black level. Presently a gamma correction of 0.7 is used which produces an overall gamma of 1.4. It may be desirable to continue with an overall gamma of this order; this will have to be determined by subjective tests. If it is found that a lower gamma is required there are two methods of achieving this which are currently being investigated. One of these is the use of diffuse light sources in the film projectors and the other is the use of a vidicon tube with a lower gamma.

(3) Output Circuit

To produce the signal in a form suitable for transmission the output from the gamma corrector is adjusted to a level of 90 IRE units, a setup signal of 10 IRE units is added to protect the picture blacks from being clipped by stabilizing amplifiers and a synchronizing signal of 40 IRE units is added. (140 IRE units represents 1 volt.) The final output of the telecine when reproducing the stairstep test slide is shown in Fig. 6.

Evaluation

For reviewing films and slides with the standard reproducing characteristic a high-quality picture monitor with 100% d-c restoration is used. This monitor is situated in the TV control room which has a low level of ambient lighting. It is not considered desirable to pre-distort the transmission of television signals to attempt a compromise for poor home viewing conditions (such as no d-c restoration and high ambient lighting) at the expense of those viewers who have established a good home viewing condition. There is very little compression of gray scale between the control room and the home receiver (especially via transmitters which have been modified for color transmission) and it is therefore possible to view the same gray scale on a home receiver as that displayed in the TV control room. There are indications[6] that the quality of the average home receiver will eventually be improved in the same manner as improvements have been made to radio reception by the introduction of "high-fidelity" receivers. For example, a number of receivers provided with d-c restoration are available. In the author's opinion, this is an important step in the right direction toward the introduction of high-fidelity television.

The originally stated objective of this investigation was to standardize the gray-scale transfer characteristic of a vidicon telecine chain so that (a) film presently used for broadcast could be evaluated for suitability and (b) the requirements for exposing and processing film suitable for television could be determined.

Since the standard reproducing char-

acteristic was established and the test slides were developed and manufactured a considerable number of films and slides have been evaluated for suitability. One telecine chain is set aside each morning for evaluation screenings and a great number of people concerned with the production of TV films and slides have attended these sessions. Several hundred films and many hundreds of slides have been evaluated. The main purpose of these screenings has been to demonstrate in what manner some of the film material now received for broadcast is unsatisfactory. Some improvement in quality has been made as a result of these screenings alone but no significant improvement is expected until the data for proper exposure and processing for meeting the television requirements is published. This paper and the accompanying two papers represent the first general outline of these requirements.

Broadcast

For broadcast the telecine equipment is first set up for the standard reproducing characteristic, but for unsatisfactory film the waveform requirements of the television system are met by manual adjustment of the gain and black level controls.

When reproducing film with the specified minimum and maximum densities of 0.25 and 1.85 the controls are automatically reset to the standard condition since this is the condition for a proper output waveform. Thus if a film is evaluated with the standard characteristic and found to be entirely satisfactory then it will be broadcast in an identical manner to that displayed during the evaluation screening. Film which is shown to be unsatisfactory during evaluation will be improved slightly during broadcast by manual adjustment of the telecine equipment but can never be made to reproduce as well as the film which meets the requirements of the standard characteristic.

Table I. Diffuse Densities.

Step No.	Dd	De	Te	Lv	Ev	Ec	Eg	Eo
1	0.25	0.340	1.000	1.000	1.000	1.000	1.000	100.0
2	0.32	0.444	0.788	0.792	0.859	0.846	0.889	90.1
3	0.40	0.562	0.600	0.608	0.723	0.697	0.777	79.9
4	0.49	0.695	0.441	0.452	0.597	0.558	0.665	69.9
5	0.59	0.843	0.314	0.327	0.483	0.433	0.557	60.1
6	0.72	1.036	0.202	0.217	0.371	0.310	0.441	49.7
7	0.87	1.258	0.121	0.138	0.276	0.206	0.331	39.8
8	1.07	1.534	0.061	0.080	0.193	0.115	0.220	29.8
9	1.36	1.983	0.023	0.042	0.127	0.043	0.110	19.9
10	1.85	2.708	0.004	0.024	0.088	0.000	0.000	10.0

Dd = Diffuse density of stairstep slide.
De = Effective density = $(1.48 \times \mathrm{Dd}) - 0.03$
(This represents the straight line most closely matching the measurements of EIA sub-committee TR-4.4.2.)
Te = Effective transmission relative to step #1 = $\dfrac{\mathrm{Antilog}\,(-\mathrm{De})}{0.457}$
Lv = Light on vidicon tube = Te + 2% flare = $\dfrac{\mathrm{Te} + 0.02}{1.02}$
Ev = Vidicon output = $\mathrm{Lv}^{0.65}$
Ec = Black clipper output = $\dfrac{\mathrm{Ev} - 0.088}{0.912}$
Eg = Gamma corrector output = $\mathrm{Ec}^{0.7}$
Eo = Telecine chain output in IRE units = $(90 \times \mathrm{Eg}) + 10$

Appendix

Table I gives the diffuse densities of the ten steps of the calibrated stairstep test slide and shows how these densities are converted by the vidicon telecine chain into equally separated steps of output voltage.

Step 1 producing an output level of 100 IRE units represents television white level.

Step 10 producing an output level of 10 IRE units represents television black level. The brightness of the picture monitor being used for evaluation is adjusted until step 10 is situated at subjective black for the particular level of flare and ambient light present on the face of the picture tube.

The complete relationship between diffuse density and output level in IRE units is given by the expression:

$$\mathrm{Eo} = 90\left\{\frac{\left[\dfrac{\left\{\dfrac{10^{-(1.48\mathrm{Dd}-0.03)}}{0.457}\right\} + 0.02}{1.02}\right]^{0.65} - 0.088}{0.912}\right\}^{0.7} + 10.0$$

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Part II: Telefilm Density and Exposure Control

By HAROLD WRIGHT

A system for making 16mm film for television broadcasting is called Teledexicon. It is based on the establishment and maintenance of standardized characteristics for telecine reproduction, the film process and the printing operation. It permits relatively inexperienced personnel to achieve high accuracy in negative exposure and predictable TV gray scale from release prints. Live TV studio output and telecine film output may be made to have matched gray-scale characteristics. Exposure is determined by measuring scene element luminances with a spot photometer and relating it to telecine video voltage with simple rotary calculators. Teledexicon permits accurate control and prediction of gray scale, lighting key and mood while shooting is in progress and before the film is processed. Objective measuring techniques are used throughout.

Introduction

In the January 1951 *Journal*, H. J. Schlafly made the following statement[1]: "The ultimate objective of both television and photography is the faithful reproduction of the original scene. But, while the beginning and end products are the same, the medium and methods are widely different. Thus, it is little wonder that there are few, if any, existing experts who are so thoroughly familiar with the terminology and techniques of both sciences that they can point out in advance, the areas of confusion or misunderstanding."

Perhaps the two sciences have been dealing with the same thing in slightly different form without realizing it. For many years the motion-picture industry has been successfully producing waveforms in soundtracks. It is only a short transition to the development of television picture waveforms from film materials. Variations in density in the picture are translated into variations in voltage in the transmission signal as the picture is scanned by the telecine equipment. Highlights, or minimum densities, produce the maximum signal excursion and from it develop television "white level." Shadows, or maximum densities, produce the minimum signal excursion to establish television "black level." This total signal excursion determines the modulation of the picture transmitter. The transmission of the picture is therefore dependent on the range and values of density in the film. From this it should be obvious that the production and control of films for television must be based on a density concept and the accurate production and control of densities.

Evaluation of Film

It has been pointed out by Schade[2] in 1951 that motion-picture materials for television use should be adjusted to fit the range and transfer characteristics of the TV system and not the eye.

The telecine reproducer exhibits none of the psychological or psycho-physical characteristics of human vision. It is almost a measuring device, examining quite impartially the highest density, the lowest density and the range and relation of densities lying between the end points. For example, the appearance of a performer's face on a TV film program will not be determined solely by the density of the face tones, but by a combination of this and the density separation of face densities from maximum and minimum densities. The vidicon as a density measuring device has already been suggested in a paper by Boor.[3]

The telecine chain must be the starting point in any attempt at either film evaluation or the devising of a system for making television films. Fortunately the vidicon lends itself readily to standardization, as set forth in the accompanying paper by Murch.[4]

Teledexicon, a New Approach to the TV Film Problem

It is emphasized that the system described in this paper bears no resemblance to the traditional approach to film production. Objective measuring techniques are used throughout for exposure, processing and reproduction. The relation between objectivity and subjectivity has been explored thoroughly by James and Higgins.[5] The wide divergencies between this technique, where absolute figures are used, and the older technique using exposure indices is indicated if reference is made to Kodak literature.[6]

This system does not use exposure indices. It relates scene element luminances directly to negative densities, using a spot photometer. Nor is this new, because such a technique was described as early as 1933 by Gundelfinger and Stafford[7] as a means for obtaining greater uniformity in the exposure of multicolor negatives. The system is new mainly in a reorientation of thinking and approach to the problem. It has been named Teledexicon, which stands for Telefilm Density and Exposure Control.

While Teledexicon is dependent on objective measuring techniques, no attempt has been made to produce conditions of materials usage difficult for a "normal" film laboratory to handle. Negative gamma is in the neighbourhood of 0.65 and positive gamma close to 2.65. Negatives are exposed so as to utilize a portion of the toe and the exposures therefore are close to that implied by the fractional gradient criterion of exposure indices. The two, however, cannot be directly compared because exposure indices imply an integrating meter plus wide tolerances and the Teledexicon method measures scene element luminances with narrow tolerances.

Television engineering groups have, in the past, often emphasized the need for exposing TV negatives on the straight line portion of the negative characteristic. Data accumulated during the developmental periods of this project, show nothing which will support this concept. The necessity of using a portion of the negative toe region has been admirably developed by Dunn[8] and will not be reiterated in this paper. The perils of overexposure have also been indicated in Kodak literature,[6] and in a recent paper by Baines.[9]

It was considered that a primary requirement for television film was to match it accurately with live studio material. Most of the mismatches between the two which are commonly seen may be attributed to differences in tonal rendition, particularly in shadow detail areas. To overcome this, the system was designed to be capable of producing transmission voltage characteristics similar to those produced by a live TV camera. In CBC practice, monochrome TV cameras are adjusted with reference to the EIA (formerly RETMA) logarithmic gray-scale reflectance chart. Cameras are operated sufficiently over the knee to produce linear crossed staircase signals from the chart. The chart's chip reflectances start at 3% with a multiplying factor of approximately 1.46 and rise to a reflectance of 60%. When evenly illuminated the chart luminances follow a logarithmic law. This means that the live camera delivers linear voltage increments for log scene element luminance increments over the major portion of its transfer characteristic.

For television film to match this live camera characteristic it is necessary, by

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way of the film process, to have linear telecine output voltage increments for log scene element luminance increments at the location where the negative is exposed.

System Requirements

The requirements of the system are as follows:

1. A standardized telecine reproducing characteristic.
2. Negative image-forming conditions designated by a characteristic curve with predetermined specifications.
3. Positive image-forming conditions designated by a characteristic curve with predetermined specifications.
4. An exposure level in printing determined by test material with specific characteristics.
5. An exposure level at the taking camera based on scene luminance to telecine video output voltage relations.
6. An electronic spot photometer together with revolving calculators to determine the lens aperture setting and lighting intensities.

To simplify the detailed description which follows it will be confined to the RCA TK 21A vidicon chain, Eastman Plus-X Panchromatic Negative Film, Type 7231, and Eastman Fine Grain Release Positive Film, Type 7302. End densities used are 1.85 maximum and 0.25 minimum. Video levels will be referred to in IRE scale units with 10% setup at all times. It is emphasized, however, that the philosophy of this system is not tied to any particular film stock, end densities or telecine reproducer. With suitable correction factors, easily arrived at, Teledexicon may be applied to any film stock, to any end densities agreed upon as a suitable standard and to any reproducer having a known and constant transfer characteristic.

The simplest possible case, that of a two-generation process, has been examined in detail in order to move exposure control, printing control and playback control into the realm of objectivity. The techniques of applying sensitometric control to the duplicating stages of multigeneration operations are already well established in the film industry and there should be no difficulty in applying the system to multigeneration film operations.

Probably the greatest advantage offered by Teledexicon is the ease of its adoption by relatively inexperienced groups. Film industry cameramen of long-term experience are able to obtain a high degree of exposure accuracy when operating in familiar surroundings and with one specific laboratory. This ability is rare among television film groups and it is unnecessary with this system, because relatively inexperienced cameramen are able to obtain high accuracy in negative exposure, and with the laboratory standardization program described in the accompanying paper by Ross[10] it makes little difference which laboratory the negative is sent to.

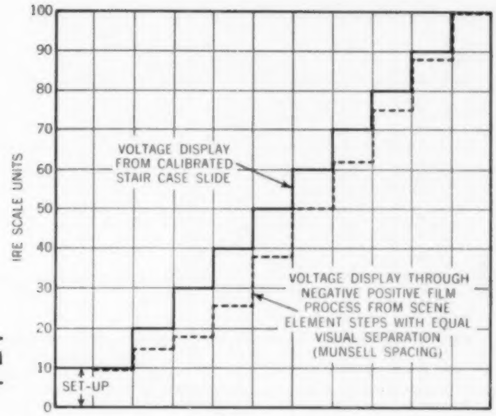


Fig. 1. Comparative staircase voltages from calibrated test slide and negative-positive film process.

Standardized Telecine

This subject has been covered in detail in the accompanying paper by Murch[4] but one aspect of it requires reiteration here. The test slide described is not a linear density slide but has step densities following a characteristic complementary to that of a commercial vidicon camera.

The range of densities required to produce linear voltage output steps on the commercial telecine chains examined, is shown in Table I. Note that, at the dense end, a change in density from 1.85 to 1.35 (a 0.50 density difference) is required to produce a video output voltage increase of 10 IRE scale units while at the white end of the scale a density increase of only 0.07 will reduce the output by 10 IRE scale units. Ten IRE scale units is the same as one tone step in the TV picture and this means that to achieve a one-step separation in shadow detail in the telecine picture there must be a density difference of 0.50 in the film print.

This telecine characteristic, which is representative of a commercial multiplexed chain using electronic black stretch, will produce some compression of blacks if equal visual scene steps (Munsell values) are translated through the negative-positive film process, into IRE scale units. In Fig. 1 a ten-step staircase voltage produced through the negative-positive film process from a ten-step Munsell scale is compared with the linear staircase from the test slide. Although there is some black compression it is not particularly evident when pictures taken under the same conditions, are evaluated subjectively under controlled viewing conditions.

The essential factor in this phase of the system is repeatability of the standardized reproducing characteristic. With the methods outlined by Murch,[4] telecine chains in different locations may be made to have the same reproducing characteristic plus a day-to-day repeatability for any one chain. Only after this is an accomplished fact, can other phases of a film production system be properly developed.

Table I. Densities for the Calibrated Television Staircase Slide.

Test slide densities	*IRE scale indications*
0.25	100
0.32	90
0.40	80
0.49	70
0.60	60
0.72	50
0.87	40
1.07	30
1.35	20
1.85	10

Negative Image-Forming Conditions

The negative characteristic and tolerances established for this system are shown in Fig. 2. Standard negative image-forming conditions are an essential part of the system. The characteristic is determined by exposing samples of the selected negative stock in the sensitometer and adjusting processing until a negative gamma of 0.65 is obtained. This conforms with normal film industry practice. A departure from normal approaches lies in the care with which the *position* of the characteristic curve on the graph, is maintained. The location on the graph must be maintained within the following tolerances:

The density difference between two steps, ten steps apart, on the straight-line portion of the negative characteristic must be 1.00 ± 0.05 density.

The density of Step 9 on the sensitometric step wedge (for Eastman 7231 Plus-X negative stock) must be 0.62 ± 0.02 density. The methods of obtaining and maintaining such negative image-forming conditions are covered fully in the accompanying paper by Ross.[10] The above conditions are, at the present time, tied to the CBC Eastman Model 6 Type IB sensitometer in the CBC Toronto TV film processing laboratory.

When the Canadian Subcommittee of the SMPTE Laboratory Practices Committee completes its work of sensitometer

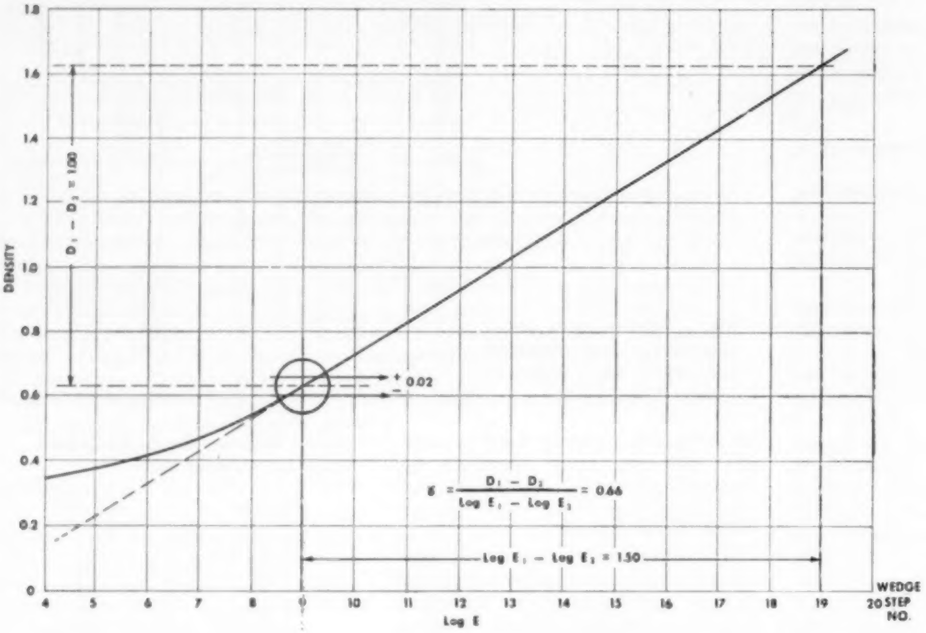


Fig. 2. The standard negative characteristic and tolerances for Eastman 7231 stock.

standardization in Canada, it will not be necessary to refer the system to a specific sensitometer.

It is also realized that changes in the inherent characteristics of film batches will need to be taken into account. This does not appear to be a serious problem at the present time. One run of test shooting using this system employed three different emulsion batches and the differences were negligible. Another test shooting made several months later, showed no appreciable speed change. When differences do occur, they can be spotted by regular sensitometric testing and any correction factor required could be applied to the exposure calculator wheel in terms of stops or fractions of stops.

Standard Positive Image-Forming Characteristics

The positive sensitometric characteristic and positive tolerances established for this system as applied to Eastman 7302 stock are shown in Fig. 3. The characteristic is established by exposing samples of the stock in the sensitometer and adjusting processing until a positive gamma of 2.65 is obtained. The tolerances are as follows:

The density difference between two points four steps apart on the straight-line portion of the characteristic must be 1.6 ± 0.05 density. The density of Step 15 (for Eastman 7302 stock) must be 1.10 ± 0.05 density.

The methods of obtaining and maintaining such positive image-forming con-

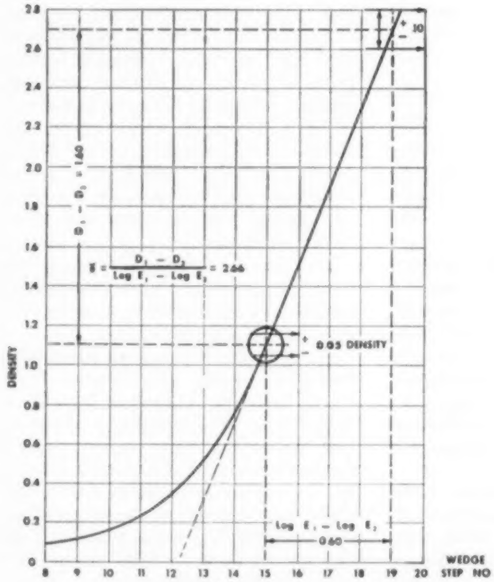


Fig. 3. The standard positive characteristic with tolerances for Eastman 7302 stock.

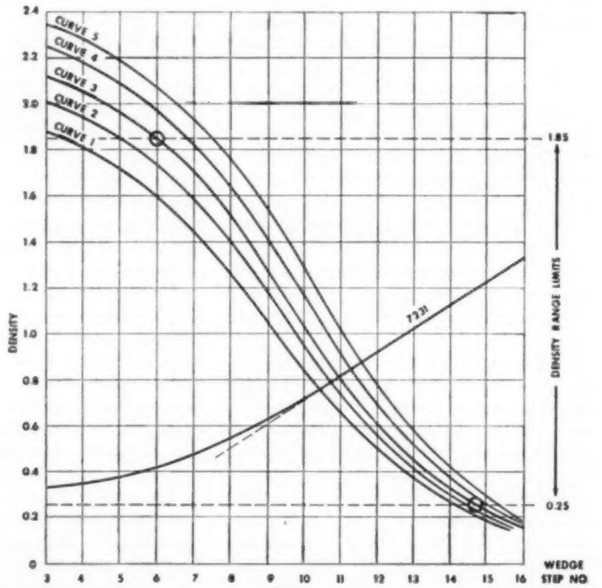


Fig. 4. The standard negative characteristic with a family of positive print-through characteristics obtained at a number of adjacent printer lights on Eastman 7302 stock.

ditions are also covered by Ross in the accompanying paper.[10]

These conditions do not represent wishful thinking but show the confidence we have developed in the inherent reproducibility of the photographic process over a period of five years and a hundred million feet of release positive from the CBC Toronto film laboratory. The remarks already made regarding sensitometers and film emulsion batches apply equally well here.

Printing Exposure Level

The characteristic required to relate positive densities to video output voltage is the print-through characteristic. This is determined by printing a test loop containing the standard negative sensitometric wedge at a number of printer lights as shown in Fig. 4. From the family of positive print-through characteristics obtained, one is selected which meets the end-point density requirements of television film and relates them to a specific scene luminance scale. In this case the end points are 1.85 and 0.25. These are peak densities and represent a film contrast range of approximately 40.1. It is felt that the film concept of "areas in which it is required to produce detail" is obsolete and that a set of peak densities must be stipulated for television film together with an indication of the tonal dynamic characteristic between the end-density points. The curved nature of film transfer characteristics makes it inadvisable to attempt correction of unsatisfactory negatives by printing them up or down or by juggling the positive gamma. This may produce the correct end-point densities while at the same time introducing serious tonal distortion in the picture, including black compression, white compression and displacement of face densities relative to minimum densities.

In Fig. 4 the chosen characteristic is shown as Curve 3. Once the required print-through characteristic is established, all future adjustments to printing light intensity are made by running a test printer loop negative wedge through the printer at several printer light numbers. The one matching the characteristic Curve 3 in Fig. 4 most accurately is then used to print the picture negatives. This light is used for all shots and scenes without variation. Thus, by this system, printing levels are determined by objective means using measured materials rather than by subjective evaluation of the picture content and are not adjusted from shot to shot. It is not necessary to refer to the picture content during this stage. A suitable tolerance for the printing operation is ± 0.50 printer light.

For example, if the test wedge print-through curve was displaced from the desired characteristic by more than 0.50 printer light, then, on current commercial printers, the next nearest light in the

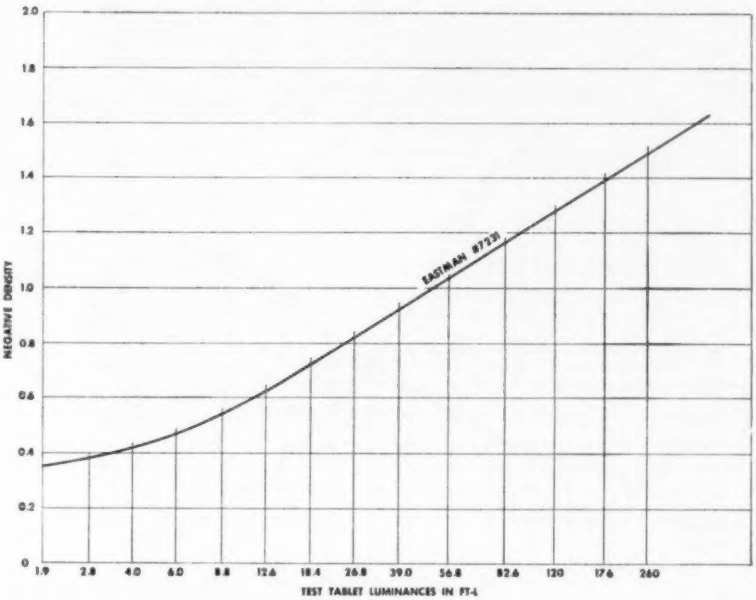


Fig. 5. Log increments in scene luminance related to negative density for Eastman 7231 Negative Stock at an exposure of f/4.0.

direction of the desired characteristic would automatically provide a print-through characteristic less than 0.50 printer light away from the required one.

It is suggested, that for greater accuracy, a printer light control calibrated in lights, half lights and quarter lights would be desirable.

Camera Exposure Level Determination

It is unfortunate that TV film production techniques are not able to take advantage of the work of Jones and Condit,[11,12] Sorem,[13] Moon and Spencer,[14] and many others who have made valuable contributions to the study of negative exposure.

In all of this work the objective has been to arrive at an exposure condition which will produce a negative from which a "print of high quality" may be obtained. But this "print of high quality" is established through psycho-physics by a panel of observers or judges. Those prints considered acceptable will encompass a considerable variety of total print contrast ranges. If such a subjectively acceptable group were reproduced on a telecine chain, the visual tone reproduction characteristics would be determined by the video waveform generated and might bear little resemblance to the tone scale of the original material due to establishment of video black and white levels. This destroys the very basis of their original acceptability and makes necessary a totally different approach to television film negative exposure.

The exposure of negatives in the camera must be such as to relate a usable scene element luminance range, by way of the standardized processing and printing system outlined, to the gray-scale test slide and therefore to telecine.

The first step in this procedure is to establish a known relation between measured scene element luminances and negative densities. The procedure is as follows:

A logarithmic series of test luminances is set up, using neutral cards and adjustable lights. The step-by-step increase in luminance is based on a multiplying factor of approximately 1.46 to achieve a common base between live studio practice and film shooting practice.

This is simply an extension of the EIA scale from 9 steps to 15 steps. The luminances are carefully established by measurement with an electronic spot photometer, taking care that the test card has even illumination over its entire surface, and that the photometer is looking at the tablet from the same angle as the camera. The test exposures are made with a 16mm film camera, at a lens aperture of *f*/4.0 and running at 24 frames/sec. The area of each test tablet is made to fill a large part of the frame to make density readings convenient. The exposed negative is then processed to the standard described and the negative densities are measured. When these data are plotted against the negative characteristic the results are as shown in Fig. 5. This establishes the first phase by relating scene element luminances to negative densities at a specific lens aperture.

If the data for the test slide are now combined with the printing characteristic and plotted on the data of Fig. 5, the result will be a composite graphical analysis of the entire system on a single piece of paper. This composite is shown in Fig. 6. From it the transfers from scene

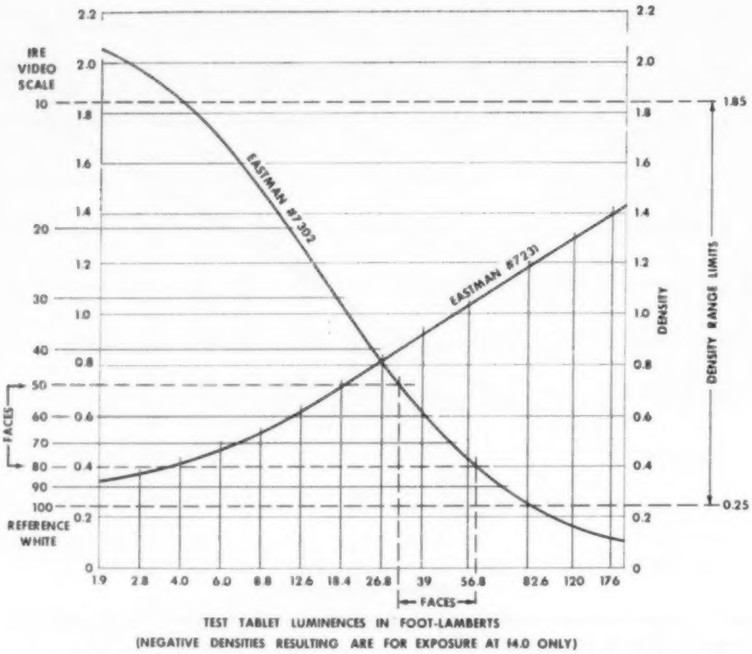


Fig. 6. Teledexicon complete transfer negative and print-through characteristics which might be selected as the target in a controlled laboratory process.

element luminance to negative density to print density to telecine video output voltage, are readily traced. These data form the heart of the system. From it, simple exposure and lighting calculator wheels may be designed. This group of transfer characteristics remains constant, within the tolerances previously given and thus enables "on location" prediction of the final result by checking the scene luminances with a spot photometer.

An examination of Figure 6 will also show the very limited scene luminance scale which would result if only the straight-line portions of the negative and positive characteristics were used. It is the print-through characteristic which the telecine chain sees and unfortunately the straight-line portions of the negative characteristic and the straight-line portions of the positive print-through characteristic only coincide over a small portion of the Log E scale. Much of the print-through straight line is lost in the negative toe region and vice versa. Reducing positive gamma does not correct this situation because it also decreases the slope of the print-through characteristic at the dense end, where it has already been shown that a steep slope is necessary to compliment the telecine transfer characteristic. In Figure 6 the coincidence of truly straight-line negative and positive characteristics only encompasses a scene contrast range of 3:1. Even the inclusion of the small curvature in the early toe part of the positive print-through curve will only extend this to about 8:1.

The range shown in Figure 6 for face luminances, requires some explanation. This is again based on TV live studio practice where the video voltage level for faces is seldom allowed to drop below 50 IRE scale units, or rise above 80 IRE scale units. A good mean would be about 65 IRE scale units and for the end densities of 0.25 and 1.85, this would mean face densities of 0.55 in the print. Within the suggested range, faces may be set brighter or darker, depending on the composition and mood requirements of the material.

It is emphasized that, for TV film, a statement about face densities is meaningless unless, at the same time the peak maximum and minimum densities are also stipulated, and the reproducing characteristic is known.

Exposure Calculator Wheel

The data in Figure 6 is only valid for exposure at *f*/4.0. Simple arithmetic will permit this to be expanded into a table of values for other degrees of exposure as shown in Table II. This table shows only maximum (telecine peak white) and minimum (telecine black level) luminances plus a tolerance range for face densities. It is obvious that such a table cannot be conveniently used by a cameraman; the risk of error would be too great. But if it is developed into a basic rotary calculator (Fig. 7) the cameraman may determine his exposure very rapidly. For example, a peak white luminance of 332 ft-L would require exposure at *f*/8. The deepest shadow should be no lower than 16 ft-L and faces may

Table II. Luminances for White and Black Video Peak Voltage and for Maximum and Minimum Face Tone Voltages at a Range of Stops and Half Stops From f/2.8 to f/32.

Lens f/stops	Peak white	Face luminance Max.	Face luminance Min.	Minimum luminance
2.8	41.5	29	17	2
3.2	62	43	25	3
4.0	83	57	33	4
4.5	125	85	49	6
5.6	166	114	66	8
6.3	249	171	99	12
8.0	332	228	132	16
9.1	498	342	198	24
11.0	664	456	264	32
12.5	996	798	396	48
16.0	1328	912	528	64
18	1992	1368	792	96
22	2656	1824	1056	128
25	3984	2736	1584	192
32	5312	3648	2112	256

range from 132 ft-L to 228 ft-L with a mean of 196 ft-L. Because average fair skin reflects about 35% of the light falling on it, the incident lighting levels may be calculated roughly at 500 to 600 ft-C.

Exposure Tolerances

Control of exposure appears to be fairly critical. The electronic spot photometers used to establish exposure are rated with an accuracy of ±5% of the meter scale reading. This does not introduce measurable variations in the telecine output from a print.

The calibration of such meters is easily maintained by regular reference to a brightness standard.

The setting of apertures is another matter. A one-stop error will double or halve the exposure produced by a specific scene element luminance. This cannot be successfully overcome by adjustment of printer light intensity.

As an example, an assumed overexposure error of one stop is examined in Fig. 8. The correct exposure for the range A – A is *f*/4.0 and would produce end densities of 0.40 and 1.2 in the negative and 0.25 and 1.85 in the print. An accidental overexposure of one stop would move the luminance range two log E units to the right or position B – B. This would produce end densities of 0.55 and 1.4 in the negative. If the print-through characteristic of Fig. 8 is used, the print end-densities would be 0.12 and 1.45 and the relations between face densities and end densities would be altered.

An increase of several lights at the printer would bring the maximum densities back to normal but the minimum densities would not follow at a similar rate, and the result would be a print with extended contrast ranges. The results of a one-stop underexposure would be even more difficult to correct. This is also illustrated in Fig. 8 and if the print characteristic of Fig. 8 was used the re-

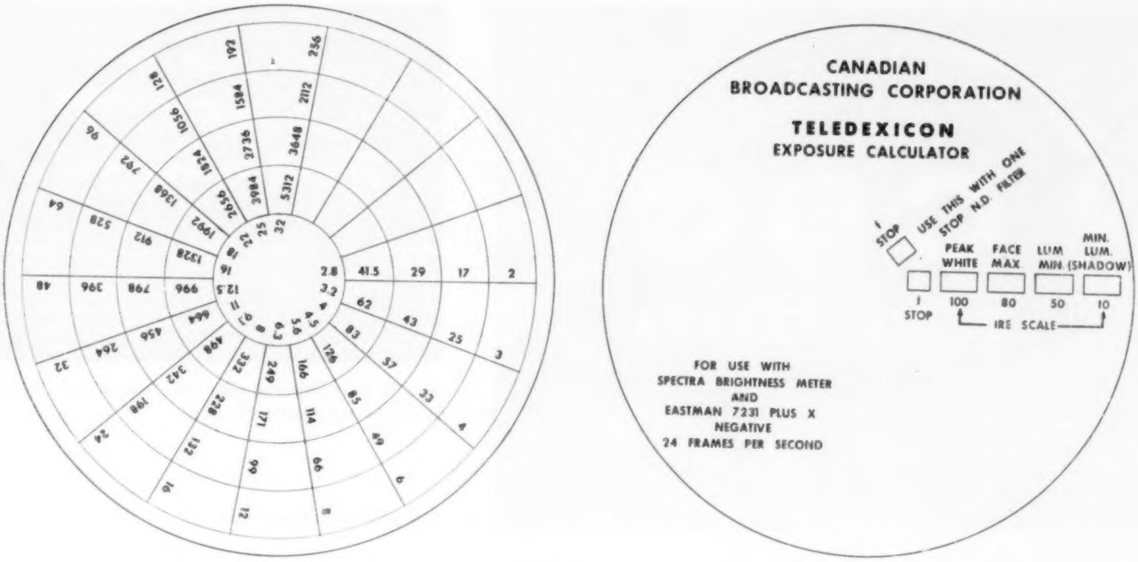


Fig. 7. Construction of a basic rotary calculator based on Table II.

sulting print density range would be from 0.62 to 2.06. A reduction in printing intensity of two printer lights would bring the maximum densities back to about 1.80 but would only reduce the minimum densities from 0.62 to 0.50. But even more important is the shape of the print-through characteristic in these regions.

This would be in the shoulder region where the shape of the density curve is the very reverse of the desirable one indicated earlier. Such an error in exposure would produce black compression in the telecine picture output. All this does not mean that an accidental error in exposure cannot be salvaged for broadcast by a temporary adjustment of printer light intensity.

As a further control check, it is recommended that the first few feet of each negative used should be exposed, on location, to a Kodak Neutral Test Card. The luminance of the card in foot-lamberts and the aperture used should be indicated on the exposed, packaged negative before it is given to the laboratory. These test cards are double-sided with a reflectance of 90% on the white side and 18% on the gray side. Serious errors in exposure would then show up when the negative density was measured and suitable temporary steps could be taken to correct it as far as possible. A further useful test card would be one having a reflectance of 35%. This should be placed in one of the chief positions for performers' faces and dealt with in the same way as the previous cards.

Because of the critical nature of exposure it seems desirable to have the exposure scale marked in half and quarter stops. There is nothing unreasonable in being this meticulous about camera exposure. Experienced Hollywood cameramen work regularly to an accuracy of $\frac{1}{3}$ stop. It becomes, in practice, a matter of measuring peak luminances, consulting the calculator wheel and selecting the nearest stop or fraction of a stop.

A tolerance of $\pm\frac{1}{4}$ f/stop is satisfactory at this stage in the system.

Application of Teledexicon to Shooting Graphics

Application of this system to shooting graphic art in the form of titles or animation sequences is relatively easy because all visual materials are under direct control. The required video voltages for the visual result expected are converted into luminance and then into reflectances. This permits arriving at specifications for papers, cards, inks and paints. An artist's gray scale may be constructed and, provided the artwork is lighted evenly to a specific luminance and exposed at the correct aperture, the results will always be predictable and end-point density requirements met on every job. There is little problem of excessive contrast ranges in this work. It is difficult to exceed a 30:1 contrast range, in fact the greatest difficulty seems to be in per-

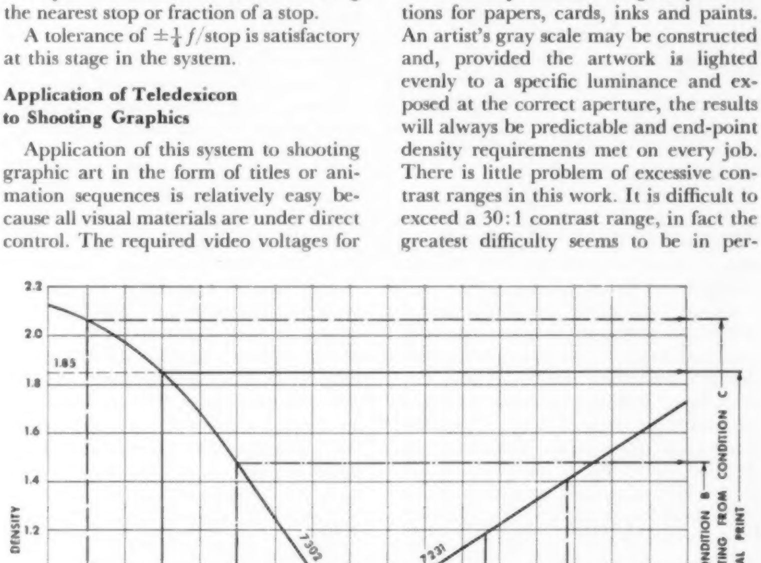


Fig. 8. Composite negative-positive plot showing the effect of a one-stop overexposure and a one-stop underexposure.

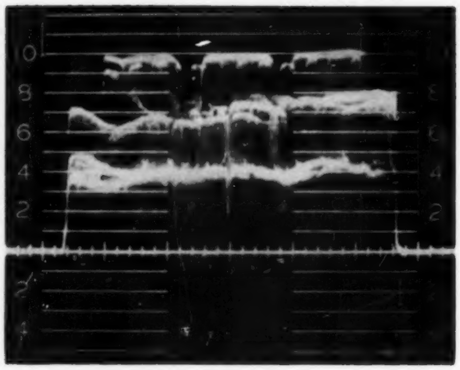


Fig. 10. The telecine line rate waveform display from a 16mm print of the cue.

Fig. 9. The CBC Network cue.

suading the artist to make full use of the available range. Most good matte black cards and papers have reflectances no lower than 4%, special paint formulas may achieve 3% (equivalent to a Munsell 2/value); good white papers and paints seldom exceed 80% to 85%. The calibration of such materials has been described in a previous paper.[16] In using the stop-frame feature of animation stands it will be necessary to apply a correction factor to compensate for the difference in exposure time.

An example of the application of the system to graphic art is the CBC network cue shown in Fig. 9. CBC programing requirements demand that the cue be available on 16mm positive film.

Figure 9 shows the visual appearance of the cue and Fig. 10 shows the waveform produced by it. When this cue was produced, the artwork was first roughed out as to form, then the transmission signal characteristics decided upon. Using the standard transfer characteristics based on data shown in Fig. 6, the required art work reflectances were plotted, and the illumination level and shooting aperture requirements worked out. The cue prints now automatically provide correct signal characteristics and a reference signal for telecine each time the cue film is used.

Application to Studio Shooting

This is not as difficult as might be expected. There is much similarity to live TV studio practice. Lighting and staging are important. If settings or costumes contain highly reflective materials it may be difficult to preserve the correct ratio between face luminances and highlight luminances. This situation will be aggravated if the high reflectance areas are in a horizontal plane, such as the top surface of a lounge chair or table, or the treads of stairs. These surfaces may intercept considerable amounts of light, mostly from backlights, and may have very high luminances.

The approach to establishing correct exposure in studio work will be different from the approach to outdoor work. In the studio all the lighting elements can be controlled in direction, distribution and intensity. The depth of field requirements are considered and this yields an f/stop number. Using the calculator wheel, the cover is rotated until that f number appears in the window.

The scene lighting intensity must then be adjusted to yield the luminances indicated for faces, white peaks and black peaks. In the example of Figure 11 an aperture of f/5.6 is assumed. This would require studio highlights to have a maximum luminance of 166 ft-L. The deepest shadow should be no lower than 8 ft-L. If deeper shadows are found they must be lifted by the addition of fill light. The majority of areas of low luminance in an average scene will have reflectances lower than the reflectances of scene highlights. But even so, the low-level fill light required for this purpose will raise the luminance of shadow areas sufficiently without seriously affecting the highlight areas. The luminance range for faces is 66 ft-L to 114 ft-L with a probable mean, depending on mood, of 98 ft-L to yield a face video level of 70 IRE scale units. Assuming an average human skin reflectance of 35%, this would mean a lighting intensity of approximately 300 ft-c incident. The photometer readings must be taken from a point as close to the camera lens as possible. Many types of diffusing surfaces will give misleading luminance readings if the angle between the key light, the surface and the photometer lens is not the same as that between the key light, the surface and the camera lens. This applies to both the vertical and horizontal angles.

Highly reflective clothing near the face could produce difficulties. If the performer was wearing a white blouse with a reflectance of 80% (not unusual for many white clothing materials) and the key light fell on both face and blouse, the face would have the required luminance of approximately 100 ft.-L but the blouse would deliver approximately 240 ft-L which is much too high.

The solution to this is similar to the one employed as a control measure over black halos on image orthicon cameras. The white blouse is replaced by an off-white, buff or pastel tint of lower reflectance. In the example above, where the lighting intensity was assumed to be 300 ft-C, the blouse would require a reflectance of approximately 55%. As indicated in a previous paper,[16] pre-

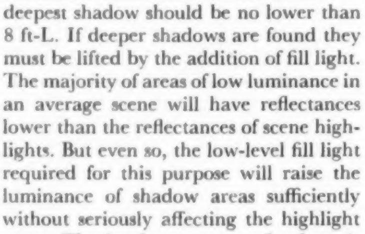


Fig. 11. Window section of calculator wheel set at f/5.6.

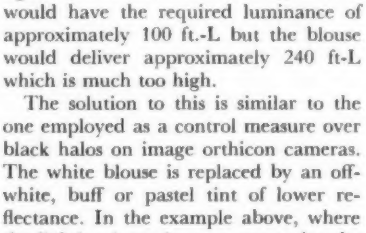


Fig. 12. Window section of calculator wheel set at f/6.3.

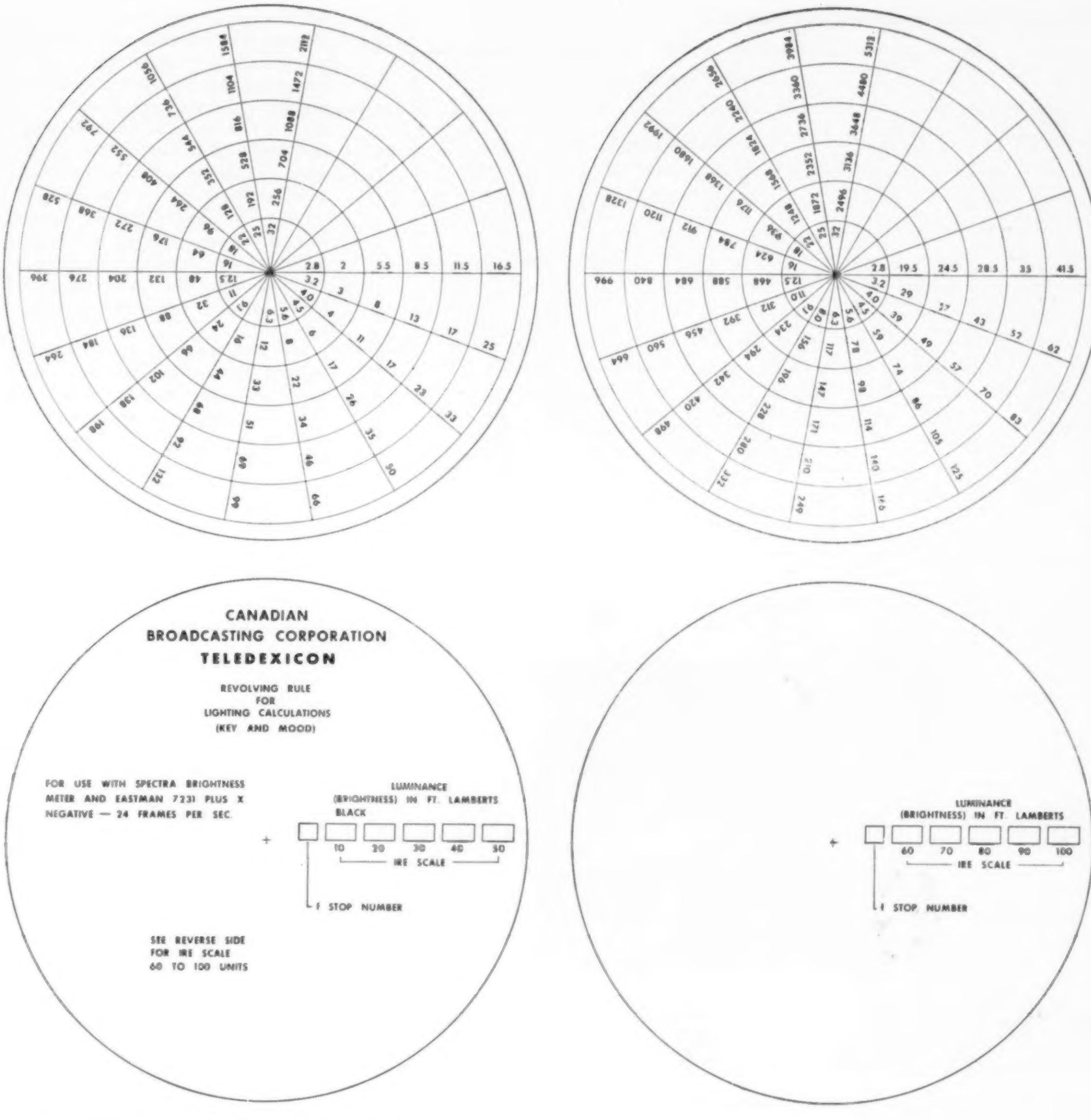


Fig. 13. Construction of a lighting calculator wheel.

checking such materials is easy if a device such as a Baumgartner reflectometer is used. But suppose the blouse has arrived and cannot be changed. If the luminance of the blouse is allowed to represent peak white, and the exposure wheel is consulted, a $\frac{1}{2}$-stop reduction in exposure would bring the blouse back to normal. But this changes all the other luminances as well, as shown in Fig. 12. At 100 ft-L, the face will be at the bottom of the range, a video voltage of only 50 IRE scale units — and this may be too dark to suit the program requirements. In addition, all set lights and fill lights would require readjustment. This latter example is given merely to show the value of costume control in preference to attempts at juggling the lighting.

The technique of supplying black and white references is also similar to that used in live TV studios. With the combination of staging, lighting and props, various objects in the scene may be made to produce the required luminances for peak white and peak black in the television transmission signal, without disturbing the mood or composition of the shots.

It was stated that one purpose of the system was to match telecine film to live studio tonal characteristics.

This produces a need for more detailed information on the relation between scene element luminances and the IRE video voltage scale. In Table III, luminances, at various lens aperture settings, are given for each 10 units in telecine video voltage. Again, the table is too cumbersome for operational usage and must be developed into a handy rotating form, as shown in Fig. 13. Used by the technical supervisor and the lighting technician, this revolving table provides almost the equivalent of a waveform monitor, when film shooting is in progress.

The wheel is used to set the level of fill lights when attempting to create specific moods. Shadow details are measured with the spot photometer, the wheel is consulted and required adjustments are made. In Fig. 14 a typical set of studio luminances is shown on a reproduction from a Polaroid Land shot of the scene. Figures 15 and 16 show respectively an enlargement from the 16mm negative and the waveform produced by it from a standardized vidicon telecine chain.

Anyone who is inclined towards men-

Table III. Values for Lighting Adjustments.

LENS f-STOP NO.	IRE SCALE 10	20	30	40	FACE TONES 50	60	70	80	90	100
f 2.8	2	5.5	8.5	11.5	16.5	19.5	24.5	28.5	35	41.5
f 3.2	3	8	13	17	25	29	37	43	52	62
f 4.0	4	11	17	23	33	39	49	57	70	83
f 4.5	6	17	26	35	50	59	74	86	105	125
f 5.6	8	22	34	46	66	78	98	114	140	166
f 6.3	12	33	51	69	99	117	147	171	210	249
f 8.0	16	44	68	92	132	156	196	228	280	332
f 9.1	24	66	102	138	198	234	294	342	420	498
f 11.0	32	88	136	184	264	312	392	456	560	664
f 12.5	48	132	204	276	396	468	588	684	840	996
f 16.0	64	176	272	368	528	624	784	912	1120	1328
f 18	96	264	408	552	792	936	1176	1368	1680	1992
f 22.0	128	352	544	736	1056	1248	1568	1824	2240	2656
f 25	192	528	816	1104	1584	1872	2352	2736	3360	3984
f 32	256	704	1088	1472	2112	2496	3136	3648	4480	5312

ALL LUMINANCE VALUES ARE GIVEN IN FT-L

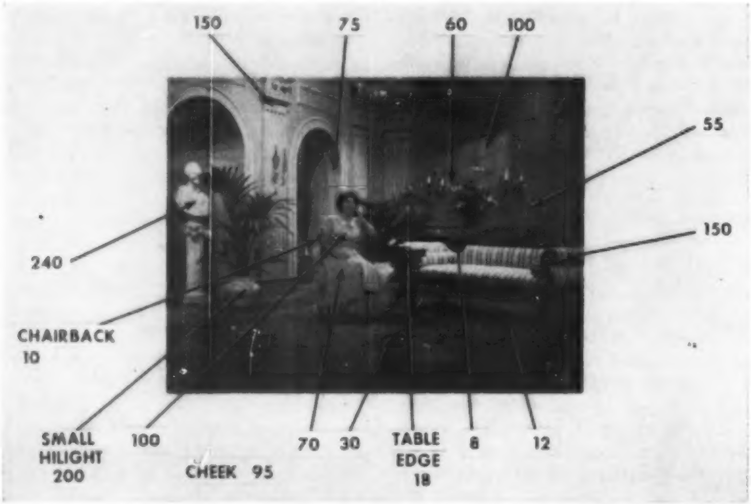


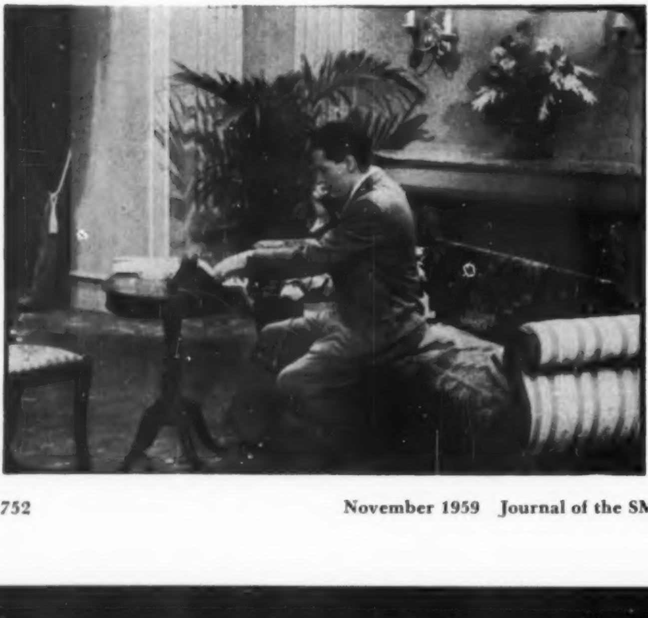
Fig. 14. Studio scene showing typical luminances.

tal arithmetic will likely have noticed that the total contrast range in the studio examples is only about 20:1. This does not mean that the system could not be modified to accommodate wider contrast ranges. The restriction is a deliberate one and conforms to normal live TV studio practice. This is a further assistance toward unifying the two methods of obtaining TV pictures. Staging procedures and materials, lighting methods and facilities are readily interchangeable between film studio shooting and live studio shooting when similar ranges are used.

The interchangeability applies also to lighting personnel. Those with extensive live studio experience are able to apply their knowledge and experience to film lighting operations. It will no doubt be realized that overall technical supervision is necessary so that predictions for pictures and waveforms may be properly arrived at. The supervisor requires an extensive knowledge of TV transmission waveforms to make the subtler aspects of this technique effective.

Application to Outdoor Shooting

Lighting intensities outdoors are dependent on many variables such as time and weather and are relatively unpredictable. The method of applying this system to outdoor shooting is opposite to that of indoor shooting. The composition is examined and highlights in the scene are measured with the photometer. In outdoor work, particularly in summer sunshine conditions, objects such as white painted walls, white cumulus clouds etc., will have high values of luminance in the order of 5000 to 10,000 ft-L. If the rotary calculator of Fig. 7 is consulted, it will be found that stopping down to $f/32$, will only accommodate peak highlight luminances of approximately 5300 ft-L when using Eastman Kodak Plus-X negative. Many of the lenses on 16mm cameras are incapable of stopping down below $f/16$



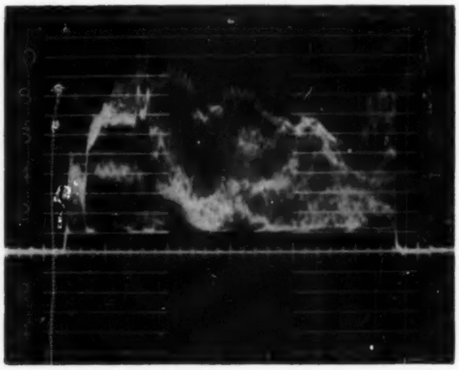


Fig. 16. Telecine line rate waveform for photograph in Fig. 15.

Fig. 15. Shot taken in set shown in Fig. 14 (enlarged from 16mm negative).

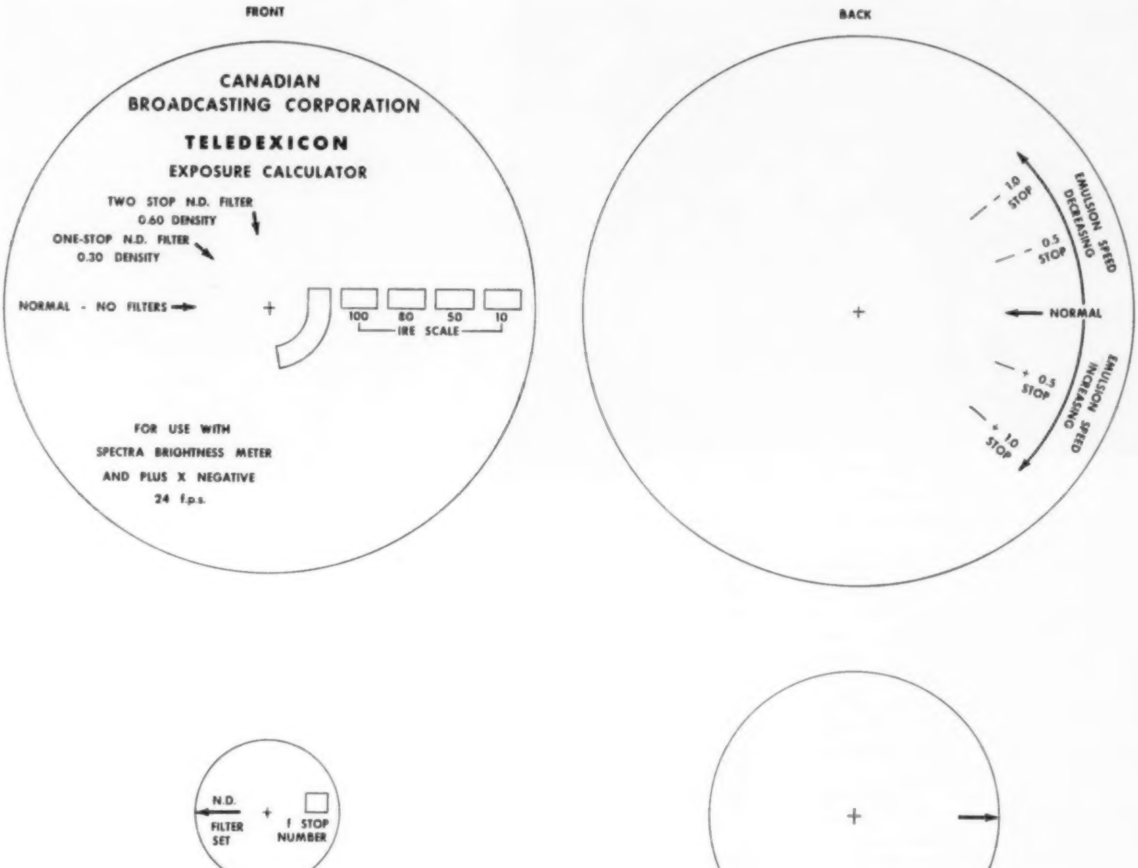


Fig. 17. Construction of advanced rotary exposure calculator.

or $f/22$, at the most even if it was desirable to do so. This means that the cameraman must carry a set of one-stop, two-stop and three-stop neutral density filters when using negative stocks such as Eastman Plus-X. In the more advanced revolving calculator of Fig. 17, a further movable section provides for compensation when neutral density filters are used.

This avoids errors in reading the scales. In this calculator, a small back wheel with detents provides compensation for changes in the inherent speed of film emulsion batches.

The literature shows much disagreement about the average luminance scale for outdoor scenes, ranging from Logan[16] 11.6:1 to Jones and Condit[11, 12] 160:1.

Although extremely high contrasts can exist in outdoor scenes, the author was rather surprised to find most of the shots taken during development tests had contrast ranges of 20:1 and less. This is particularly so when lighting consists of diffuse skylight rather than open sunlight. In the example of Fig. 18 some typical luminances are shown. This shot was taken at 2.00 P.M. on the shady side of the church in mid-September, at a latitude of approximately 43° 40′ N. The sky had a medium overcast. The window frames and sills provided a white reference at 500 ft-L and set the aperture halfway between $f/8$ and $f/11$. Figure 19 shows an enlargement from the 16mm negative and Fig. 20 the waveform produced on a standardized vidicon telecine

Fig. 18. Outdoor summer scene showing luminances.

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LENS f-STOP NO.	10	20	30	40	50	60	70	80	90	100
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f 5.6	8	22	34	46	66	78	98	114	140	166
f 6.3	12	33	51	69	99	117	147	171	210	249
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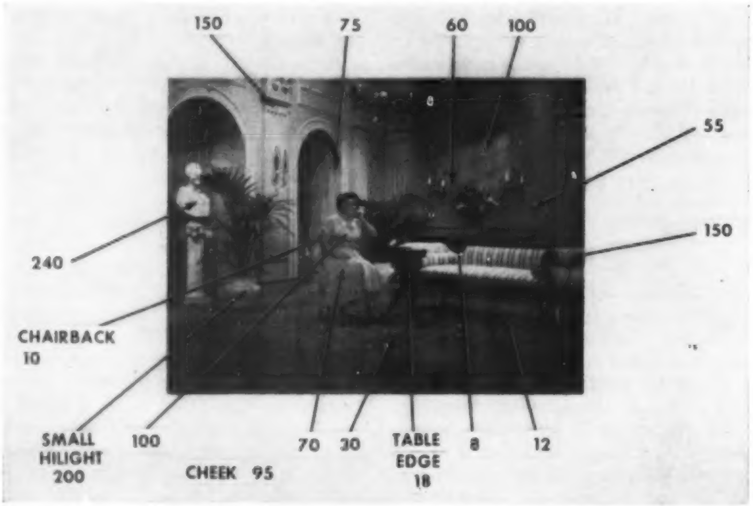

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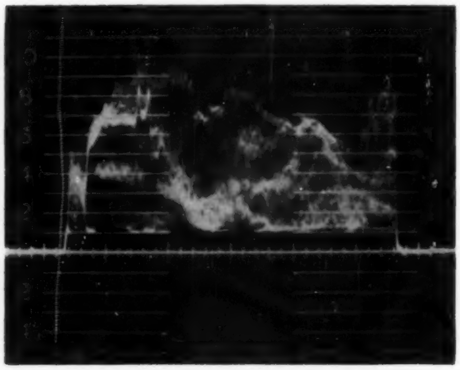
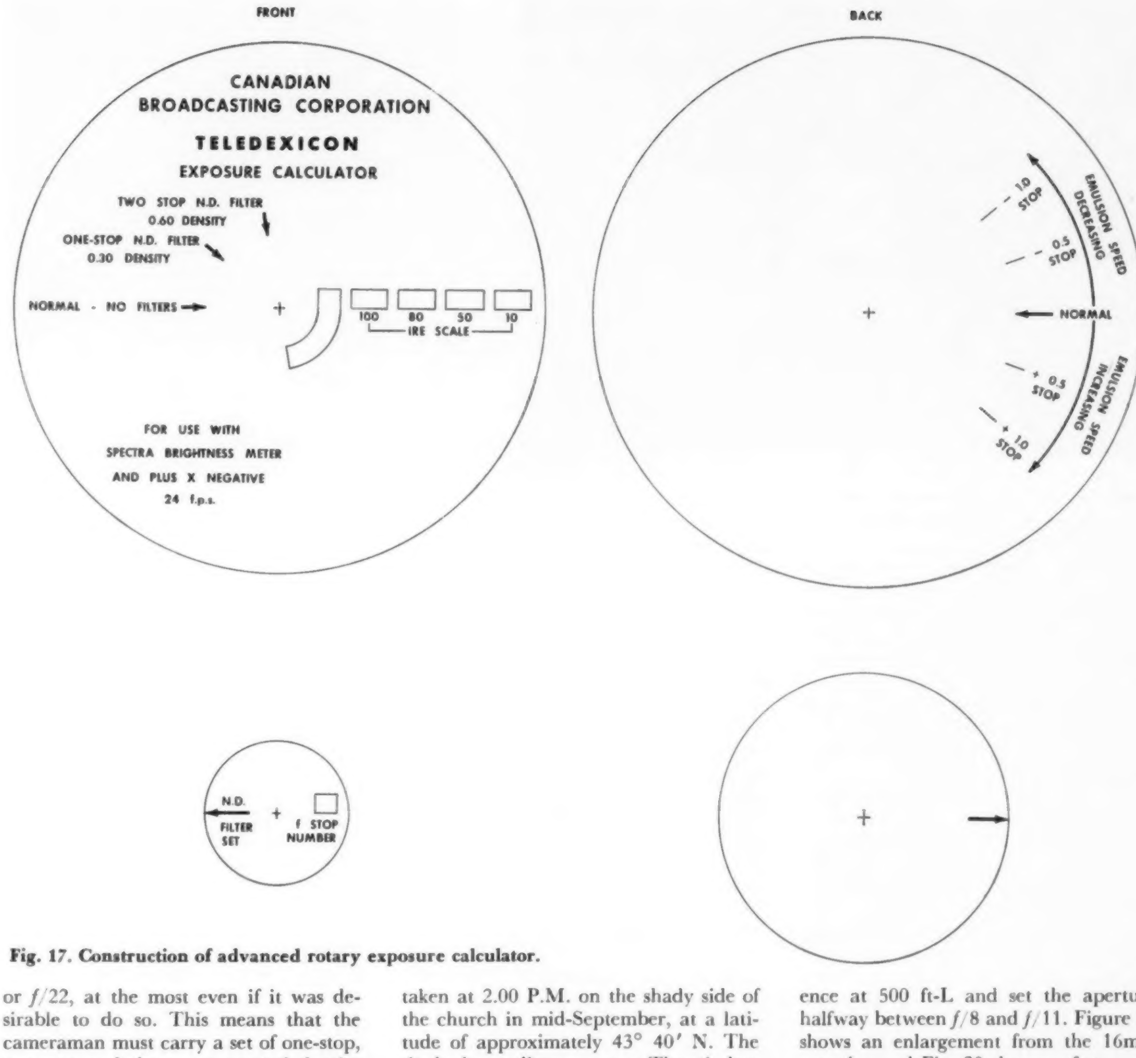


Fig. 16. Telecine line rate waveform for photograph in Fig. 15.

Fig. 15. Shot taken in set shown in Fig. 14 (enlarged from 16mm negative).



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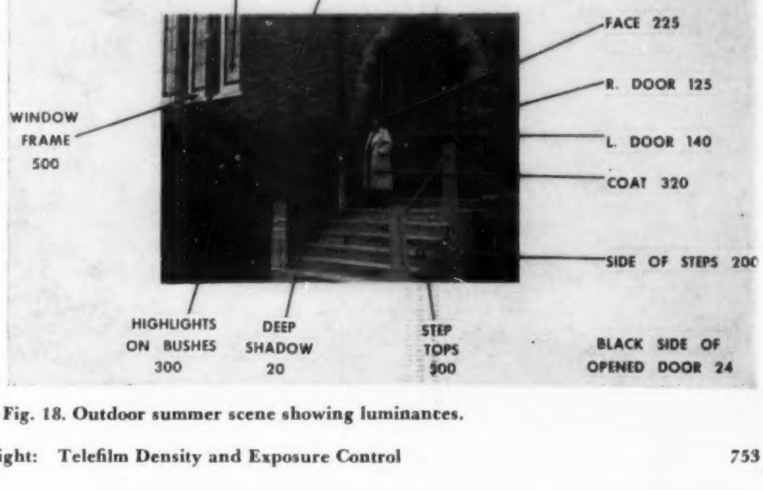

Fig. 18. Outdoor summer scene showing luminances.

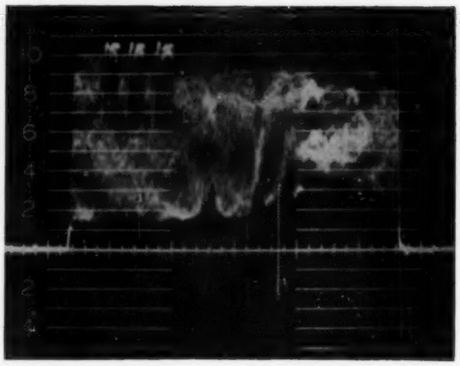

Fig. 20. Telecine line rate waveform for photograph in Fig. 19.

Fig. 19. Scene of Fig. 18 enlarged from 16mm negative.

chain. No auxiliary lights were used, as the face luminance at 225 ft-L was within the required tolerance.

Shooting in locations where there is open sun and snow-covered ground does not produce any serious problems. In the example of Fig. 21 some of the pertinent scene element luminances are indicated and the total scene contrast range is about 36:1. The exposure was based on the highest scene luminance, produced in this case by snow on the garage roof at a luminance of 4500 ft-L.

The black coat at 125 ft-L was lower than desirable. No attempt was made to raise the luminance of the coat and in transmission it was found to be very close to the required level. It was probably lifted slightly by the combined flare effect from the film camera and the telecine multiplexer. Figure 22 shows the transmission waveform for this shot.

For outdoor shooting, the exposure must be based on the object with the highest luminance, because this object will automatically establish the peak white reference in the video signal and other scene elements will be held below it by an amount depending on their density in the print. If other elements in the composition, particularly faces, have luminances too low, then the use of reflectors or auxiliary fill lights will be indicated. Establishing the intensity of such fill lights will be relatively easy, using the calculator and the photometer.

An example of this situation would be where it was necessary to shoot faces in the shadow of some structure when, in the same composition, areas lighted by open sunlight were included. Television producers invariably seem to ask for this shot. Figure 23 shows such a shot, without the use of fill light and the position of the face may be seen in the waveform of Fig. 24. Figure 25 shows the same situation corrected by fill light and Fig. 26 indicates the effect on the waveform. The fill light intensity was established by measuring the luminance of foreheads with the spot photometer. One of the most difficult situations encountered during testing periods, was one where scattered banks of cumulus clouds were moving across the face of the sun. The luminances of foreground objects varied by a factor as high as 20. But the open blue sky, facing away from the sun, will maintain a constant luminance over quite long periods. Thoughtful composition, considered in telecine video voltage as well as artistic terms, will assist outdoor shooting greatly and enable both the producer and the engineer to realize their requirements. This, combined with the skillful use of fill light, will make possible results equal to those obtained in the studio.

Incandescent and Daylight Lighting Intensities

It has been found that shooting motion-picture films with the Teledexicon system results in considerable economy in lighting. The specification sheet for Eastman Plus-X Panchromatic Negative Film, Type 7231 shows the lighting requirements for various lens apertures. For example, the number of foot-candles required for an exposure at $f/4.0$ is stated to be 320. But the incident light requirements for the system described, at an exposure of $f/4.0$, is only 140 ft c. Part of this economy results from the restriction of the scene luminance range to a ratio of 20 : 1. If the range was extended two steps this would require

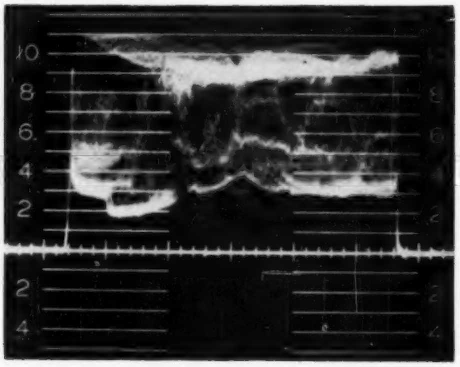

Fig. 22. Telecine line rate waveform for photograph in Fig. 21.

Fig. 21. Snow scene with typical luminances.

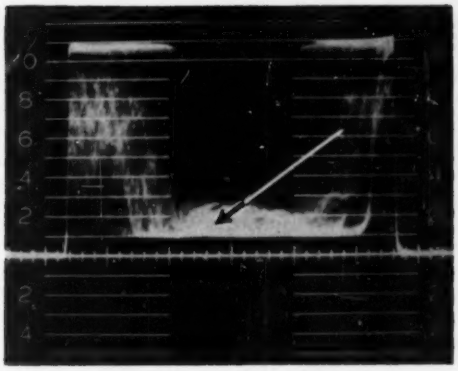

Fig. 24. Telecine line rate waveform for photograph in Fig. 23. Arrow shows voltage position for face.

Fig. 23. Shaded outdoor close-up shot without fill-light.

highlight luminances twice as great as before and would increase the incident light intensity requirements. The figures published in the Eastman specifications sheets are with reference to conventional motion-picture systems. In such systems, an exposure safety factor is incorporated in the exposure index.

With this system the only safety factor needed is the $\pm\frac{1}{4}$ lens stop previously stipulated. For studio shooting where an aperture of $f/4.0$ provides sufficient depth of field, these figures mean that programs may be filmed in a TV studio with standard monochrome TV lighting facilities and special, larger fixtures such as arc lamps will not be required. Most well-equipped monochrome TV studios are capable of producing intensities as high as 200 ft-c over large areas and 500 to 600 ft-c in limited areas.

Those studios equipped for color television will be capable of raising these figures by a factor of 3 and in such studios it would be possible to operate with Eastman Plus-X negative at apertures between $f/5.6$ and $f/8.0$. None of this has taken into account the possibilities inherent in negative stocks of higher speed than Eastman Plus-X.

With this system it has not been found necessary to make alterations in the exposure calculator when changing from daylight to incandescent light. The spectral characteristics of the electronic spot photometer used appear to be such as to largely compensate for actual differences which may exist. A neutral test tablet alternately exposed under daylight and incandescent light, and at a luminance near peak white, produced a deviation of only 0.04 density in the finished print and this is negligible. This also means there are no problems when working with a combination of natural and artificial light.

Testing Conditions

It has already been stated that this group of papers represents an engineering study of the problems of television film production and reproduction. But once the theoretical aspects were worked out the system was tested under a wide variety of conditions over a period of about ten months. Various types of indoor and outdoor scenes were shot. Indoor shooting ranged from studio locations with full lighting facilities to temporary locations with only a pair of clip-on lights available. Outdoor scenes ranged through sunshine and shade, through summer and winter, with and without auxiliary lighting equipment. Many different types of cameras were used; negatives were from many different emulsion batches as were the print stocks.

Processing and printing of test prints were randomly scattered over the ten months, but always to the standard specifications shown in Figs. 2, 3 and 6. At the end of this period about fifty short scenes were selected from the negatives, spliced together and printed at a fixed printer light set to the specifications of Fig. 6. When the print was processed it was played on the standardized telecine chain without touching gain or black level controls. Only very small deviations in black level occurred and peak white voltage variations remained within ± 10 IRE

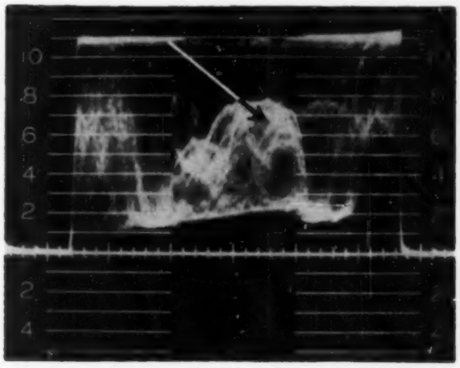

Fig. 26. Telecine line rate waveform for photograph in Fig. 25. Arrow shows voltage position for face.

Fig. 25. Same subject as Fig. 23 but with fill-light added.

scale units (equivalent to ±0.07 density approximately).

Conclusions

1. It is recommended that the proper approach to TV film production should be one which produces films requiring a minimum of adjustment during telecine playback, rather than the present trend toward telecine automatic gain controls.

2. A high degree of accuracy and predictability in the production of TV film is possible, even with relatively inexperienced personnel provided all the intermediate variables are tied down by objective tests and measurements.

3. TV live studio and film material can be matched and integrated provided the scene luminances are evaluated by a spot photometer and the necessary adjustments to lighting are made.

4. It is recommended that the Television Committee of the SMPTE should arrive at a standard telecine reproducing characteristic. Until this is done and objective test devices adopted, there will be continued confusion over the adequacy or inadequacy of TV film.

5. It is recommended that for telefilm production, a new philosophy should be adopted, to the end that peak or end-point densities rather than gamma, become the paramount factor.

6. With the tools and controls described it is possible to produce 16mm motion-picture prints which will generate predictable television transmission signals when reproduced on a vidicon telecine chain. If transmission signals are predictable, so is the tone scale and therefore the subjective quality of the reproduced picture.

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Part III. Constant Density Laboratory Process for Television Film

By RODGER J. ROSS

The requirements are outlined for a negative-positive laboratory process to obtain predictable waveforms at the output of a calibrated telecine camera chain for measured luminance of scene elements. By utilizing the inherent reproducibility of the photographic process, a constant density and density difference system may be established utilizing conventional processing and printing equipment and materials. Techniques are described for controlling the output of processing machines of the Houston Fearless type, particularly applicable to smaller laboratories associated with television broadcasting agencies. Statistical analysis of sensitometric control strips is employed to evaluate processing reproducibility. Chemical analysis of bromide content provides sufficient information to maintain image-forming conditions, when the replenishers for negative and positive developers have the same composition as the starting solutions (before the addition of bromide) and are added directly to processing machine tanks. Tolerances that may be readily achieved in the practical operation of a system of this type are given.

While it is always desirable in any motion-picture laboratory to maintain a reasonable degree of uniformity in negative and positive processing and in the exposure level at the middle of the printing scale, precise reproducibility of image-forming conditions is not an essential requirement of the motion-picture process. Many laboratories undoubtedly maintain close control of the process, but it is very unlikely that two or more laboratories in the industry can be found in which image-forming conditions are identical. Very little information is available to indicate the degree of reproducibility that can be achieved under ideal conditions or the extent of variability that might be encountered in any particular laboratory or among numbers of laboratories.

In a paper published in the *Journal* a few years ago, Goldwasser[1] made the following statements: "In processing motion-picture film it is common practice to renew solutions in the developing machines by the use of replenisher systems. Physical and chemical changes take place in the various solutions as film is processed and the used solutions, instead of being discarded, are replenished continuously and automatically. The replenisher balances out changes occurring in the solutions which would affect sensitometric properties of the film. Studies of replenishment technique in the past have been devoted primarily to developer solutions. The emphasis on developer solutions arose because small changes in composition of the developer affect the gamma and density of film markedly. Emperical methods have generally been used in establishing replenishment formulas and rates."

In a booklet published by the Eastman Kodak Co.[2] it is stated: "In view of

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the many types of processing machines used, it is obvious that no single formula is adequately suited for use under all conditions. Modifications must always be made on the basis of individual laboratory requirements."

Offenhauser[3] has stated that "among positive developer baths D-16 is widely used although in a variety of concentrations and with minor variations that depend upon specific conditions of use and in too many cases upon the whim of the man in charge. The developer is rapidly circulated through the machine by pumps, ordinarily a fairly large storage tank is used as a reservoir; the developer is circulated from the tank through the machine and back into the tank."

In a recent paper in the *Journal*[4] Lewin comments: "Our laboratory is constantly endeavoring to narrow down such variables as chemical composition, pH factor, replenishment, turbulation and temperature which contribute to density and gamma variations. But it is giving away no secrets to admit that such variations continue to exist. Every laboratory knows that quality control charts, if conscientiously maintained, will show sharp variations not only from day to day but from hour to hour."

One of the few references to precise reproducibility of image-forming conditions in processing may be found in a paper by Whitmore[5] in which it is stated: "Sensitometrically we maintain the same conditions established in immersion machine operation. In fact the gamma curves from the spray-processed H & D strips can be perfectly superimposed over the curves obtained in immersion machines."

The Target—A Constant Density Film Process

Over 70 years ago Hurter and Driffield announced that they had come to the conclusion as a result of their investigations into the image-forming process that "art in photography ceased to play any part the moment the cap was removed from the lens and that every subsequent operation, whether exposure, development, printing or enlarging, is strictly a matter of science and amenable to calculation."[6] The constant density and exposure system for producing television film is a practical application of this principle.

In 1953 the Canadian Broadcasting Corp. was faced with the problem of setting up negative-positive television film recording facilities to service a rapidly expanding coast-to-coast network of television stations pending the completion of a microwave relay service to link these stations with the major English programing center in Toronto. These facilities included a film processing and printing laboratory to permit overall engineering control of the recording process.

The aim was a recording process with unity transfer characteristic. To achieve this aim, a constant-density film process was an essential requirement.

This laboratory, with a capacity of 350,000 ft of positive prints per week, has now been in continuous uninterrupted operation for five years, and it is known that a constant-density film process within specified tolerances can be realized in practice with conventional motion-picture materials and equipment. It was the success of this undertaking that led to the development of the integrated approach to the production of television film footage described in the accompanying paper by Wright. Since normal motion-picture processing procedures were adopted for the TV film-recording operation, only minor adjustments of the process were required to process experimental footage for this project.

Analysis of Process Variability

In the operation of a constant-density film process there are two basic problems: first, the analysis of image-forming conditions to determine the nature and extent of deviations which may be occurring; and second, the application of this information to correct or compensate for deviations in image-forming conditions.

It is common practice in the motion-picture industry to process sensitometric strips at intervals and to plot characteristic curves on graph paper to measure gamma. The most elementary form of process control is the adjustment of processing machine speed to maintain constant gamma.

Plotting of the entire characteristic curve for each sensitometric strip is a tedious and time-consuming procedure. An additional and even more serious disadvantage is that it is not a simple matter to compare successive characteristic curves over a period of time. It is only by comparison of sensitometric data that variations in image forming condition, apart from gamma, can be detected.

By measuring the densities of a small number of selected steps of control strips and plotting these densities on a statistical control chart, control data may be assembled in a much more comprehensive and accessible form, with the expenditure of much less time and effort. The steps selected for measurement should include at least two on the straight line portion of the characteristic curve, one at the upper end, and the other at the lower end near the toe; and at least two steps in the toe, one of which should be just above base plus fog.

Precise reproducibility of image-forming conditions in processing will result with this procedure in plotted points on the control chart following straight horizontal lines at the density levels for the selected steps. Any deviation in image-forming conditions will cause the density of one or more of the selected steps to rise or fall in relation to the reference line or target.

Evaluation of Statistical Data

As $\gamma = (D1 - D2)/(\text{Log } E1 - \text{Log } E2)$ and as the relationship between successive exposure steps in the sensitometer is fixed, gamma can be readily calculated from a statistical process control chart by noting the density difference between the two steps selected from the straight-line portion of the characteristic curve.

For an Eastman Model 6 sensitometer, and positive film processed in a D-16 type developer it is likely that step 15 will occur at the lower end of the straight-line portion of the curve, and step 19 will have a density slightly under 3.0 at the upper end of the curve. In an ideal sensitometer exposure modulator the density difference between steps 15 and 19 should be 0.60. If the density difference between these steps in a processed sensitometric strip is 1.60, $\gamma = (1.60/0.60) = 2.66$.

When the entire characteristic curve is plotted to measure gamma by laying a transparent scale over the graph paper, and processing machine speed is adjusted to maintain gamma, any variation in image-forming conditions will shift the entire curve to the right or to the left on the graph paper, but these shifts can be detected only by superimposing graph sheets to compare the location of the curves, or alternatively by observing the density of a particular step of successively processed sensitometric strips.

In a statistical process control chart, any variations in image-forming conditions will be reflected as deviations above or below the target lines in the densities of selected steps. By adjusting machine speed as required to maintain the density of the selected step at the upper end of the straight line portion of the characteristic curve, any change in image-forming conditions in the developer will be reflected as independent variations in the density of the selected step at the lower end of the straight line. By maintaining the density of the step at the upper end of the curve as close as possible to the target, a basic reference point for the control of processing may be established.

If the density of the upper step and the difference in density between the upper and lower steps on the straight-line portion of the curve remain constant within the appropriate tolerances, it can be said that constant image-forming conditions in relation to gamma

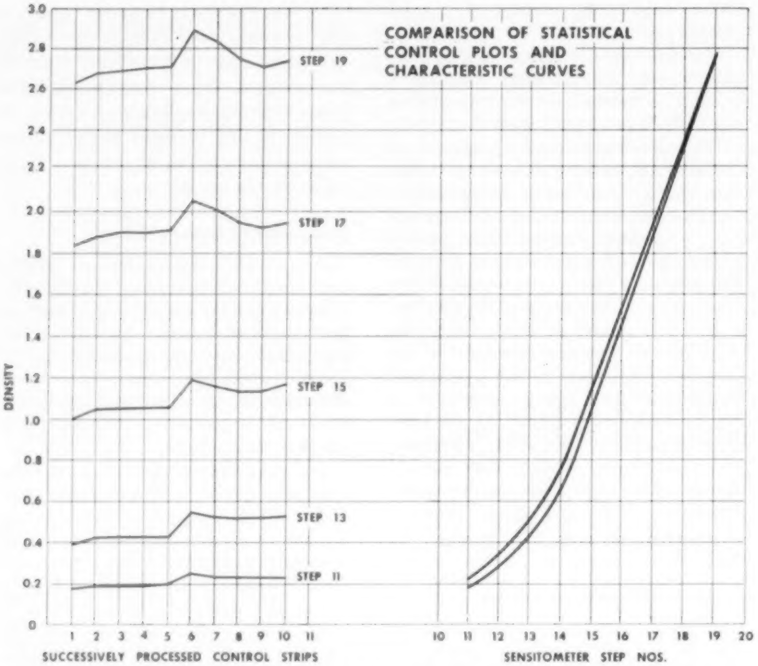

Fig. 1. A comparison of statistical control data and characteristic curves selected from two points in the control chart, indicating the greater sensitivity and intelligibility of the statistical control method.

and effective film speed are being maintained.

Analysis of Process Variations

One of the most important advantages of the statistical process control procedure is the ease with which deviations of this kind may be detected. Figure 1 illustrates this point.

Here we have a condition in which a change was made in the processing of positive film, extending over a period of about five hours. On the left side of the illustration the changes which took place in the densities of 5 steps of the control strips are shown. When the change in the process was made, the densities of all 5 steps increased. Immediately, the processing machine speed was altered to bring the density of step 19 down to normal. It was then discovered that step 15 leveled off at a density 0.09 higher than before the change was made. At the right side of the illustration, two characteristic curves have been plotted, corresponding to strip Nos. 5 and 9 — that is, the strips processed before the change was made and after the process was again stabilized. In the operation of a constant-density process a deviation of this extent is a serious matter and must be promptly corrected. The greater sensitivity and intelligibility of the statistical process control method should be obvious in this illustration.

By plotting the densities of at least two steps in the toe of the curve, any alteration in the shape of the toe can be readily detected. One of these steps should be close to base and fog in order that variations in fog level can be observed.

Control of Exposure Level in the Sensitometer

Type IB sensitometers are commonly used in the control of motion-picture processing. So long as sensitometric strips are utilized only to control gamma, variations in exposure level will not adversely affect the results. But in the statistical control of a constant-density process, variations in exposure level in the sensitometer cannot be tolerated.

Control of exposure level in IB type sensitometers is very difficult and uncertain with available equipment. The usual method for controlling illumination level at the exposure plane is by adjustment of lamp current. This of course alters the spectral distribution of the illumination. Considerable variations are likely to be encountered in the densities of the steps of the exposure modulators (step tablets). In use, the surface of the step tablet or its protective covering may become dirty or abraded, altering the transmission in a nonlinear manner.

Calibration utilizing a reference lamp, is dependent upon the densities obtained in test strips. Long-term calibration of sensitometer exposure level can be maintained only by retaining a roll of reference film for test purposes, but

Table I. D-16m Positive Developer.

Metol	1.05	grams
Sodium Sulfite	42	"
Hydroquinone	5.2	"
Sodium Carbonate	26	"
Potassium Bromide	2	"
Water	1	liter

the characteristics of film gradually change with age.

Some users of IB type sensitometers have devised photometric procedures for calibrating exposure level. There is a definite need for improvement in this area, possibly by providing an accurate internal calibration arrangement, independent of the film stock and processing.

As an indication of the importance of accurate setting of lamp current, it might be noted that for positive film exposed in an Eastman Model 6 sensitometer a change of 0.10 amp in lamp current will produce a change in density of about 0.17.

Control of Image-Forming Conditions

Now that the target, precise reproducibility of image-forming conditions in processing, has been established, and sensitive methods for detecting deviations have been described, some consideration must be given to the means by which the target can be achieved in practice.

When a laboratory was set up in 1954 by Canadian Broadcasting Corp. to process film recordings, a solution for the problem of precise reproducibility of image-forming conditions had to be found.

As a starting point it was assumed that if a replenisher solution with the same composition as that used to fill the machine tank at the start, was run into the machine at a sufficiently rapid rate, allowing the excess to run to waste through the overflow, it should be possible to maintain the original image-forming characteristics of a fresh solution. Using Houston Fearless Model 22B processing machines, a modified D-16 positive developer formula as shown in Table I and a nominal machine speed of 30 ft/min it was found by experiment that at a replenisher rate of 90 ml/min it was possible to maintain accurate image-forming conditions over long periods of time. The bromide in the replenisher was eventually omitted altogether. After a period of time, the developer in the machine tank was analyzed and found to contain 1.7 grams of bromide per liter.

With this method of operation the film being processed is the only source of bromide and the addition of bromide-free replenisher dilutes the bromide content of the solution in the machine tank to maintain this concentration. At the same time, of course, the addi-

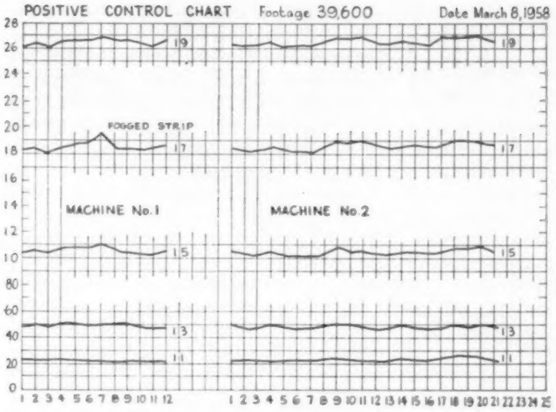

Fig. 2. A typical positive control chart covering a day's operation on two processing machines.

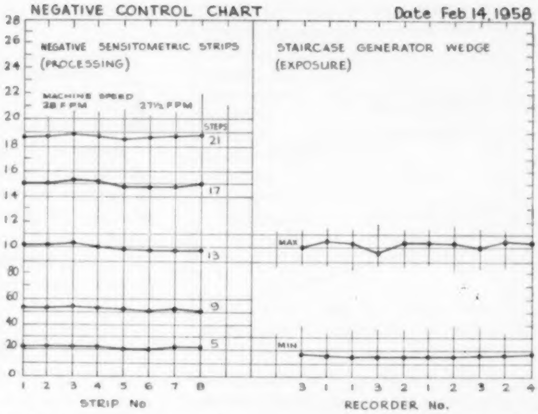

Fig. 3. A typical negative control chart for the TV film recording process. At the righthand side of the illustration the maximum and minimum densities of a staircase wedge, used in the control of exposure, are shown.

tion of a replenisher with the same composition as the starting solution (before the addition of bromide) in the machine tank tends to restore the chemical composition of the solution to its original state.

It would appear that the accumulation of bromide and the influence of this component upon image formation has far greater practical importance than any other change that may be occurring in the developer. If it is assumed that the rate of release of bromide from the film is related to the consumption of other active developer components as conversion of latent images to black silver proceeds, analysis of the bromide concentration only should provide all the information that is necessary for the practical control of the chemical composition of the developer.

Control of Bromide in the Developer

After dumping the developer tank for cleaning, the tank is refilled with replenisher solution, and the equivalent of 1.7 grams/liter of potassium bromide, dissolved in a small quantity of warm water is added. This permits film to be processed immediately, with no necessity for "conditioning" or any other adjustment of the fresh developer. At the start a slight increase in machine speed completely compensates for the slight difference in the composition of the fresh developer as opposed to a solution which has been used for some time. In five years of continuous operation, during which two positive machines have been shut down and restarted hundreds of times in this manner, no significant deviation has been noticed from an increase of approximately 10% in machine speed for a fresh solution. Over a period of 50,000 ft of film from a fresh start, the machine speed gradually returns to normal to maintain a constant-density process. Thereafter, until the machine must again be shut down only minor adjustments of machine speed are normally required to maintain the densities on the control chart.

Routine analysis of bromide concentration is carried out twice daily on each machine using the potentiometric method described by Stott.[7]

If it is observed in the plotting of sensitometric control data that the density of step 15 of the positive strips tends to drift away from the target line for this step, a change in the bromide content of the developer would be suspected, and an analysis is immediately made. In the processing of millions of feet of positive film, deviations in the density of step 15 have been traced almost invariably to a change in the bromide concentration.

If the replenisher flow is not cut off while the machine is idle or leader is running, the bromide content of the developer will be reduced, and when the next control strip is processed, it will be found that machine speed must be altered to restore the density of step 19 to normal, but the density of step 15 will be higher than normal. After analyzing the bromide concentration, the normal image-forming characteristics of the developer can be restored by adding the required amount of potassium bromide as calculated from the analysis.

It is particularly interesting to note that with this method of operation, an error of this kind can only bring the composition of the developer in the machine tank closer to its initial composition (starting solution).

On the other hand, if the replenisher flow is not turned on while film is being processed, the bromide concentration will rise. To maintain the density of step 19 the machine speed would have to be reduced, but the density of step 15 will be lower than normal. To correct for this condition, when it is detected by analysis, a calculated quantity of the solution in the machine tank is dumped out and replaced with fresh solution to reduce the bromide content to normal.

Detecting Secondary Reactions

In the operation of a constant-density film process, no unexplained anomaly can be permitted to affect the process for any appreciable length of time, since in order to avoid shutting down the operation, an adjustment would have to be made in some other phase of the process to compensate for the effects of the anomaly. Normally, sharp, erratic changes should not take place in the process, but if such do occur an immediate search must be started to locate the cause, and the search cannot be given up until the fault is corrected.

It can be readily understood by anyone with experience in a motion-picture laboratory operation that in aiming for precise reproducibility of image-forming conditions, there are a great many possible causes for deviation. An unexpected cause, that frequently interfered with the process until it was detected, is an actual rate of replenisher flow different from that indicated by the flowmeter. The solution for this problem is routine measurement of flow rate with a graduate and a stopwatch. Many other unusual and unexpected causes for variation have been encountered from time to time, but by painstaking detective work these anomalies can always be located and corrected.

With the positive processing method which has been described, it is possible to maintain the density of step 19 of the sensitometric strips within a tolerance of ±0.10, by adjustment of machine speed. By carefully controlling bromide content of the developer, the density of step 15 at the lower end of the characteristic curve can be maintained within a tolerance of ±0.05. Figure 2 is a reproduction of a typical positive process

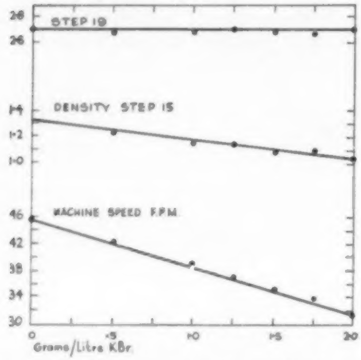

Fig. 4. The influence of increasing bromide on machine speed and the density of Step 15 of positive control strips while the density of Step 19 is maintained constant.

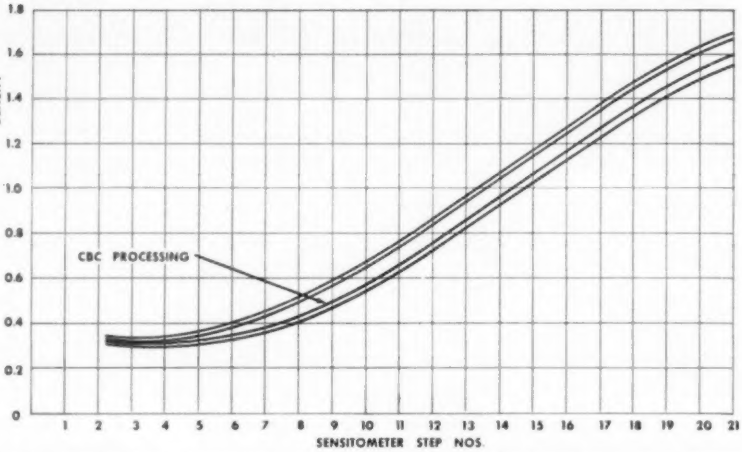

Fig. 5. A comparison of processed negative sensitometric strips from four motion-picture laboratories in the Toronto area (Feb. 24, 1959). Eastman 7231 Negative and CBC Sensitometer Model 6 were used.

control chart illustrating the degree of uniformity which is normally achieved in the routine operation of the process.

Control of Negative Processing

For the processing of negatives a D-76 type developer is used. Initially, in 1954, an attempt was made to replenish at a sufficiently rapid rate with the standard D-76 formula, but it was discovered that the image-forming characteristics of a fresh developer could not be maintained even with very high replenisher flow rate. This problem was overcome by increasing the borax concentration of the developer to 10 times its normal value i.e. 20 grams/liter. Under these conditions, no further difficulties were encountered. At a nominal machine speed of 30 ft/min and a replenisher rate of 200 ml/min, analysis indicated a bromide concentration of 0.55 grams/liter in the machine tank.

The only source of bromide in this case also is the film being processed. The equivalent of 0.55 grams/liter of potassium bromide is added to the solution in the machine tank when it is filled with fresh replenisher after being shut down for cleaning, and apart from a slight increase in machine speed at the start as in the operation of the positive machines no difficulties are encountered in duplicating the densities with fresh developer, compared to those obtained prior to shutdown and dumping.

In the TV film-recording operation, the negative processing machine is operated intermittently for approximately eight hours each day. In spite of this, image-forming conditions can be readily maintained over a long period of time. Each day the machine can be started at the same speed at which it was run the previous day, and the same densities will be obtained within very small tolerances over long periods of time. Figure 3 shows a typical negative process control chart, indicating that the extent of variability in this part of the process is quite small. In this case, a larger number of steps of sensitometric strips are measured, but this is not essential.

Some General Considerations

It has been claimed by some observers that a major factor in the degree of uniformity that can be achieved in the TV film-recording operation is the similarity in the type of images recorded on the film, and that this method of operation might be adversely affected if a variety of different types of film had to be processed. However, if the rate of replenishment is adjusted to maintain a constant bromide concentration in the developer, the processing of different types of images should present no problem. With presently available analytical methods, it might be impractical to attempt to regulate continuously the replenisher flow in relation to the rate of conversion of latent images to black silver, but it should be possible to devise a method by which the bromide concentration could be monitored continuously.

In the foregoing discussion it has been assumed that chemical changes in the developer are directly related to the rate of latent image conversion. This appears to be the case in the operation of the Houston Fearless Model 22B processor. Naturally, if some other factor is separately influencing the concentration of one or more active components of the developer, then control of bromide only may prove to be inadequate. The simplicity of this method of control would seem to indicate the desirability for closer attention to this factor in the design of processing machines.

At a replenishing rate of 90 ml/min in the positive processors and a machine speed of 30 ft/min, the consumption of developer solution is approximately three liters per 1000 ft of 16mm film, to maintain a bromide concentration of 1.70 grams/liter. Some increase in the effective speed of the film might be obtained by reducing the bromide concentration, but this would increase the consumption of replenisher. On the other hand, the consumption of replenisher could be reduced if a bromide concentration higher than 1.7 grams/liter could be tolerated, with the attendant decrease in effective film speed. At higher bromide concentrations, however, the departure of other developer components from the original concentrations might adversely affect image-forming conditions.

It should be pointed out that no attempt has been made to investigate fully the possibilities for economizing in the consumption of replenisher or for increasing effective film speed. For the TV film-recording process, a convenient operating condition was selected, and attention has been devoted solely to maintaining this condition within the smallest possible range of deviation. The influence of bromide upon machine speed and the density of step 15 in positive processing is illustrated in Fig. 4.

Figure 5 shows the results of a recent test of the negative image-forming conditions in motion-picture laboratories in the Toronto area. Sensitometric strips were processed in four laboratories and the characteristic curves were plotted for comparison. The relationship of negative processing in the kinerecording laboratory to the other three engaged in normal camera negative processing is shown. It might be noted that the bromide concentration of 0.55 grams/liter in the negative developer was selected as a compromise, to obtain a processing contrast with Eastman Television Recording Film, Type 7374, at a nominal processing machine speed of 30 ft/min, which

would permit the use of moderate video drive on the cathode-ray tube of recording equipment. In processing experimental footage for the exposure project described by Wright, the only change in the process was an increase in the speed of the negative machine to obtain a gamma of 0.65 with Eastman Plus-X Panchromatic Negative Film, Type 7231.

Exposure-Level Control in Printing

To obtain predetermined print densities from negatives, a constant printer exposure level is necessary. It should be pointed out that this is not equivalent to establishing a center printer light as in conventional motion-picture practice. The printer is calibrated by running through the machine a loop containing a standard negative sensitometric strip, and the printer setting is selected which produces a print-through curve most closely matching the target, as shown in Fig. 6 of the accompanying paper by Wright. In this illustration typical negative and print-through characteristics which might be selected as a target for a controlled laboratory process are shown.

With proper control it should be possible to print all negatives at this printer setting, thus providing what might be called a one-light printing process, and eliminating the conventional motion-picture timing procedure.

This is undoubtedly one of the most attractive features of the constant density and exposure system. The motion-picture timing procedure is entirely subjective, and it is therefore impossible for a timer to determine the printer setting required to obtain a specified density in a print for a particular negative area.

Effects on the Process of Negative Exposure Tolerance

It is interesting to note that no adjustments are required in printing to compensate for the exposure tolerance of ±¼ stop allowed in the camera as outlined by Wright. Table II illustrates the changes in negative and positive densities, and waveform amplitude which will occur due to a variation of ½ stop in the exposure of the negative. A test object, such as the 18% reflectance side of the Kodak Neutral Test Card, can be placed in the scene and photographed, to appear in the negative as an area large enough to be measured in a densitometer.

Table II shows that for a variation of ½ stop at the camera the resulting variation in amplitude on the waveform monitor is approximately 10 IRE units. Figure 6 illustrates how the data in this Table II were derived.

Control of Exposure in Negatives and Prints

It is essential with the constant density and exposure system to photograph a test object at the beginning of every negative. In the laboratory the density of this area in the negative must be measured to ensure that no errors have been made in exposure. Negatives in which the density of the test object exceeds the tolerance might be salvaged in printing, by adjusting the printer exposure level. It should be noted, however, that in attempting to salvage incorrectly exposed negatives in this way, the maximum and minimum densities (end points) cannot be matched or restored to normal at the same time, and consequently, the standard settings of the telecine reproducer would have to be disturbed to obtain waveforms suitable for transmission. This procedure will adversely affect the subjective appearance of reproduced pictures, but in case of negative exposure errors there may be no alternative.

Table II. Kodak Neutral Test Card (18% Reflectance).

Camera Exposure	−¼ stop	normal	+¼ stop
Negative Density	0.67	0.72	0.76
Positive Print Density	1.15	1.03	0.90
Waveform Amplitude (IRE units)	27	32	38

The density of the test area in each print should be measured to assess the extent of variation in the entire process, including exposure and development of both negative and positive films.

Tabulations of print densities may be analyzed statistically to detect the nature and causes of excessive variations, and to reduce variability in each stage to a minimum. With the elimination of significant process variability, attention may be directed toward other important considerations such as composition, presentation and production techniques.

Analysis of Film Batch Variations

Variations between film batches in inherent contrast and sensitivity are inevitable in all types of motion-picture

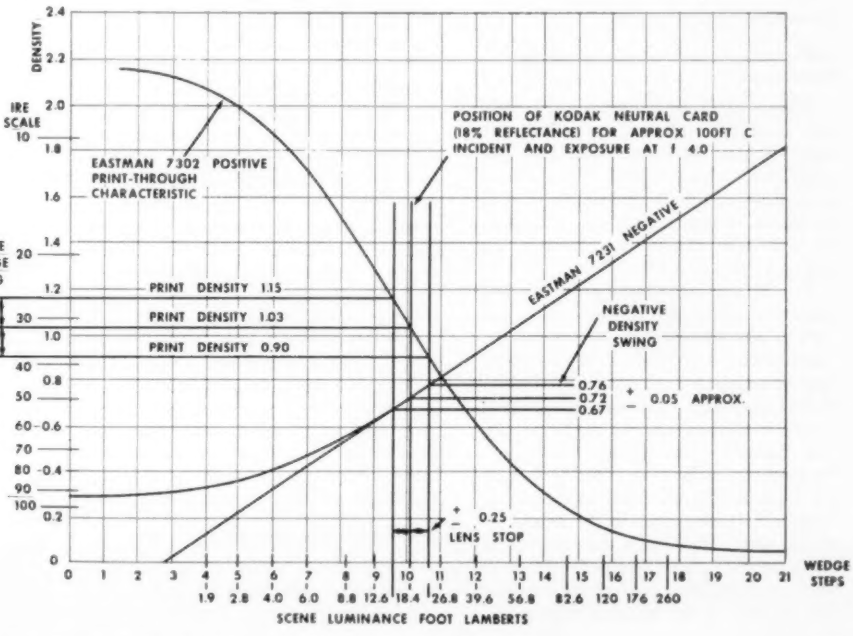

Fig. 6. Effects of a negative exposure tolerance of ± 1/4 lens stop upon negative and positive densities and waveform amplitudes.

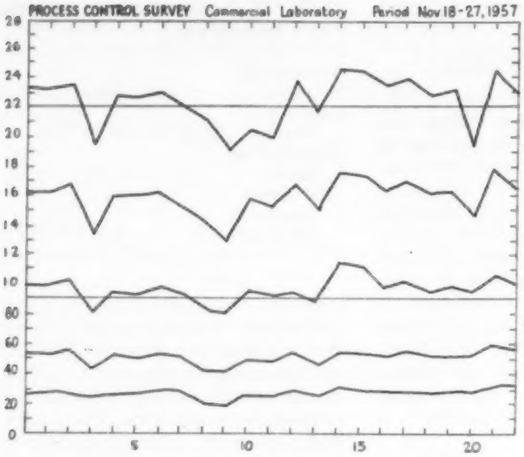

Fig. 7. Results of a survey in a commercial laboratory prior to the introduction of statistical process control procedures.

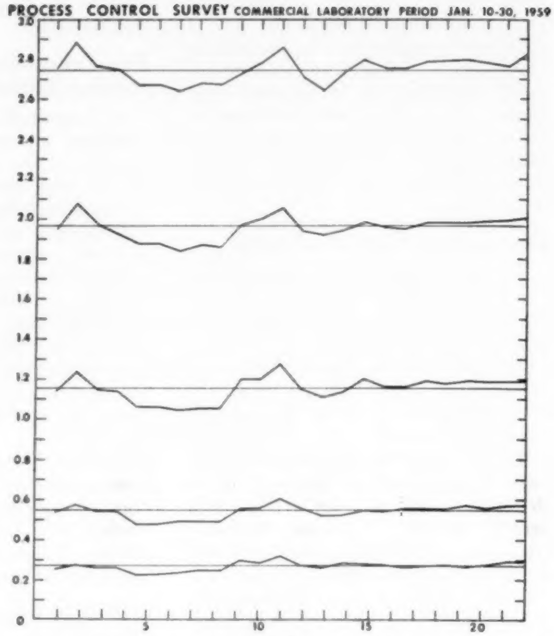

Fig. 8. The degree of uniformity achieved in a commercial laboratory by the application of statistical control methods.

work. Strips of film from the batch in use and new batch must be exposed in the sensitometer and processed at the normal machine speed for the batch in use to determine the adjustments, if any, that are required in the process to compensate for these variations. If it is found for instance that the density difference between steps 19 and 15 in the positive test strips is lower for the new batch this will indicate that the machine speed must be decreased to restore the density difference (gamma) to normal. Then it may be found that the densities of both steps 19 and 15 are lower than the batch in use. This indicates that the inherent sensitivity or speed of the new batch is lower. To compensate for the decrease in sensitivity, the printer exposure level must be raised in order that a constant-density process may be maintained.

Analysis of Negative Image-Forming Conditions

Many different types of negative film stocks are in use with widely different degrees of inherent contrast and sensitivity. While control and plotting procedures will depend upon the type of stock in use, gamma and effective speed of each type may be controlled in the same way as positive film.

By selecting and plotting the densities of two steps at the upper and lower ends of the straight-line portion of the characteristic curve, the machine speed may be adjusted to maintain the density of the upper step, while any independent variation of the density of the lower step will indicate some change in image-forming conditions in the developer. For Eastman Plus-X Panchromatic Film, Type 7231, exposed in a Model 6 sensitometer fitted with the correction filter, steps 18 and 12 may be found at the upper and lower ends of the straight-line portion of the characteristic curve. At a gamma of 0.65 the density difference between these two steps is 0.59. There should be no difficulty in maintaining the density of step 18 within a tolerance of ± 0.02, while the tolerance for step 12 should be so small that it is likely to approach the measuring tolerance in the densitometer.

The constant exposure system described by Wright requires close coordination of exposure and negative processing operations. By means of camera tests as described by Wright, the photometer readings required to obtain predetermined negative densities for a particular film process may be ascertained, in order to arrive at the appropriate setting of the exposure calculator wheel.

When the film batch or type is changed calculations from sensitometric data may be utilized to determine whether or not an alteration in the setting of the exposure calculator is necessary, or alternatively, camera exposure tests may be repeated.

Some types of film stocks do not yield a well-defined central straight-line portion in the characteristic curve. This presents no particular problem with the statistical control procedure which has been described, since more than two steps may be selected in the sensitometric strips for reference purposes if it is considered that this is advisable.

Laboratory Interchangeability

The methods which have been described for controlling negative and positive image-forming conditions were devised for a specific purpose — a TV film-recording process with unity transfer characteristic — utilizing a particular type of processing machine. The application of the proposed system on a wider scale is dependent upon the ability to duplicate these results in other laboratories. It is well known that the operation of motion-picture laboratories is highly individualistic and for this reason it might be concluded that the prospects for general adoption of the system by the industry are not very promising.

There is every reason to believe, however, that this is a much too pessimistic view of the situation. Figures 7 and 8 are "before and after" illustrations of what has been achieved in improving uniformity of positive processing in a commercial laboratory associated with CBC news film operations in Toronto.

Standardization of Laboratory Practices

This is a time of standardization and technical coordination in industry generally. It is undoubtedly in the best interests of the motion-picture industry to adopt standardized laboratory practices and procedures, in line with modern industry practice.

In May 1957, the Canadian Section of the Society set up a committee to study and make recommendations for the standardization of motion-picture laboratory practices. This group, with representation from coast to coast in Canada and a membership of about 50, has been recognized as an official

subcommittee of the Society, and has been continuously active since that time. A great deal of valuable information has been assembled through surveys of densitometers, sensitometers and printer exposure level. Four Recommended Practices are currently in preparation covering these areas of laboratory operation.

The work of this subcommittee has, of course, a direct bearing upon the constant-density system for television film which is now being proposed.

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Discussion

George Lewin (*Army Pictorial Center*): In the extensive presentation you have made, I want to refer to one slide [Fig. 1, Ross] showing step 19 very constant but with the gamma obviously dropping as you changed the speed of development. Is your conclusion that it's much better for television purposes to keep the higher density constant even though the gamma varies as a result? In other words, do you feel that gamma is decidedly less important than keeping the higher-density tablet constant?

Mr. Ross: The illustration may not have made it clear that we do maintain gamma constant — or the equivalent of gamma. The slide that was shown indicated a peculiarity in our operation that was in the process of being corrected. This was an anomaly that we encountered. Gamma — or the equivalent of gamma — is always maintained constant.

Mr. Lewin: You have already made changes which eliminate the effect you showed?

Mr. Ross: Yes, of course. For example, that might have been a change in emulsion batch which would require complete readjustment of the process, but eventually we would come back to the standard value of gamma if you measured it.

Mr. Lewin: Is the replenishment continuous whenever film is running through the developer?

Mr. Ross: The replenishment is continuous. The process is set up solely for kinescope recording. Because it was an incidental convenience the demonstration material for Mr. Wright's presentation was processed through it. The replenisher is run at a standard rate and the release of bromide from the film appears to average within a relatively small tolerance.

Mr. Lewin: Do you have some automatic means of stopping the replenisher when the film is not running?

Mr. Ross: No, that is a manual operation.

John P. Byrne (*Army Pictorial Center*): Considering that you are dealing with 7231 16mm Plus-X Film and 7302 16mm stock, I wonder if there is a slight discrepancy in that the allowed tolerance in the positive stock at each of the steps is plus or minus, I believe, 0.10 and 0.15. What was the step used, the 12th?

Mr. Ross: On the positive film it is step 15.

Mr. Byrne: That seems too great a tolerance for a laboratory processing 16mm positive film to be at plus or minus 0.15 at any step. Might it be plus or minus 0.05?

Mr. Ross: It is plus or minus 0.05.

W. A. Palmer (*W. A. Palmer Films, Inc.*): Referring to the first paper and talking about the possibility of adding diffusion to the telecine projector, have you considered the problem of the loss of definition due to diffraction of the diffused light?

Mr. Murch: We've made some tests with diffuse light with the slide projector and we have noticed no appreciable loss in resolution. Just recently, we have been trying the same test on a film projector and, for some reason which we don't quite understand, we did appear to obtain some loss in resolution before we could make any appreciable difference in the gray scale. But the tests on the 16mm film projectors were put off because we haven't been able to find a supplier of a 10-step test wedge on 16mm film, so most of our tests have been confined to the slides. To make sure that we get the same gray scale between film projectors and slide projectors, we set up all projectors to the same maximum light level before inserting any film material. But this is a problem.

Mr. Palmer: Experience in optical printing proves how difficult it is to maintain definition and still not get the increase in contrast that a specular system gives. But when we go to extreme diffusion, which we'd like to do to reduce contrast, we lose definition from an object as small as the 16mm frame. This seems a real limitation; I wonder if you've made the tests with the 16mm frame?

Mr. Murch: We did try this and we did obtain loss in resolution. This was our first approach to try to reduce the gamma by this means. If this is unsuccessful I think our next approach will be to try to find a vidicon tube with a lower gamma. We have received quite a number of tubes with a gamma very much lower than 0.65 and if we can find somebody who can manufacture these tubes with a consistently lower gamma, say of about 0.4 or 0.5, the diffuse light might be unnecessary. But this seemed to be the first thing to investigate — the diffuse light.

Mr. Palmer: Referring to the extremes mentioned for the positive densities, 0.25 to 1.85, obviously those prints are making use of a good part of the toe of the positive stock which, of course, is compatible with the fact that typical kinerecording negative stock is also exposed using the toe, and only part of the straight line. This is analogous to the early variable-density sound recording where the toe was used both in the negative and positive. But in the suggestions for the use of regular picture negative such as Plus-X or Tri-X in film production, it was not clear whether the toe end of the negative stock was used. Is it correct to assume that these exposures, or the light levels determined by your exposure method, do make use of a good part of the toe of the negative?

Mr. Wright: That's correct. We use a portion of toe; we don't go into the flatter portion. An illustration for the printed presentation [Fig. 6, Wright] shows the exact amount of the toe that is used. We also, of course, go into the toe and shoulder portion of the positive. If you were to restrict the use of this particular set of characteristics to only the straight-line portion of the negative and the positive, the area in which the straight line, the truly straight-line portions of those two characteristics coincide, would only accommodate a scene luminance range of 3 to 1—and this is not very much. And even if you used the early and shallow part of the positive toe, you'd still only be able to push it to about 8 to 1; so at the moment I can see no way whereby you can expose film in this particular fashion using only straight-line portions and at the same time accommodate any appreciable normal scene contrast range.

Mr. Palmer: That is true and it should be emphasized for anybody considering the making of films for television in this way, since this would definitely be at variance with the classic practice in photography of exposing only on the straight-line portion of the curve. Your method restricts the exposure to very narrow tolerances, whereas normal "straight-line" practice allows a tolerance of two to three stops without affecting scale. One additional thought in that connection is that this also seems to presuppose contact printing from 16mm camera negative. Would the same conditions obtain with 35mm negative reduced to 16mm where, again, we get into this problem of increased effective gamma due to the specular light that's normally used in a reduction printer?

Mr. Wright: That has not been tried because, as I suggested, we confined this study to a single, two-generation negative-positive arrangement using 16mm; but as far as I can see, it would be necessary to repeat the procedures you saw where I produced a family of positive curves. If this were done, using the actual optical printer that was to be used, and then again select the characteristic which fitted, I think you'd find that it would be quite adaptable.

Mr. Palmer: The CBC group is to be congratulated for putting proper emphasis on this matter of gray scale which I think has largely been overlooked and which, perhaps, is responsible for a large measure of the rather poor repute that kinescope recording has had. The excellent gray scale of video-tape recording has given the magnetic medium a top rating for quality in spite of many mechanical difficulties and rather restricted definition.

Mr. Byrne: Others have also had difficulty reading a 10-step wedge on 16mm. In earlier publications you have said that only the 1st, 2nd and 4th (with the 4th step having a 10th step density) have been important in the establishment of your light levels and the readings of those steps in the lab. Referring to the "staircase wedge" that is used to set up the telecine reproducer, could not 4 steps be used instead of all 10?

Mr. Ross: In that case we must have as many steps as possible in order to determine the linearity of the reproducing device. This is the reason for using 10.

Closed-Circuit Television in School and Community: The Chelsea Project

By LAWRENCE CRESHKOFF

Industrial vidicon cameras, master antenna distribution system and standard home receivers are used in a community TV station which links an elementary school, settlement house, city health center and public housing project in New York City. The instructional programs are handled by two people: the technician, who presets cameras and lights and controls video-audio; and the teacher, who operates four cameras and has charge of her own props during telecasts.

THE ABSENCE OF REAL communication among individuals and groups is often cited as one of the root causes of social breakdowns ranging from divorce to war. In our cities the influx of large numbers of migrants unfamiliar with urban living patterns and speaking in foreign tongues has frequently been followed by intergroup hostility and tension, with a multitude of stresses on the schools, the police and other public and private organs of our society. The stresses have been at least aggravated by the difficulty of communication between newcomers on the one hand, and the older residents and society's institutions on the other.

In New York City, a group of educators and social workers, interested in finding ways to speed up the assimilation process and to overcome the barriers to communication among the Mainland White, Mainland Negro and Puerto Rican residents of one neighborhood, have turned to closed-circuit television.

Presented on May 3, 1959, at the Society's Convention in Miami Beach by Lawrence Creshkoff, Chelsea Closed-Circuit Television Project, 436 W. 27 St., New York 1.
(This paper was received on August 14, 1959.)

They are experimenting with a system (Fig. 1) that ties together the local elementary school (P.S. 33), the neighborhood settlement house (Hudson Guild), the local health center and 607 apartments of a low-income public housing development (John Lovejoy Elliott Houses).

In 1957, the Chelsea Closed-Circuit Television Project was established under a grant from the Fund for the Advancement of Education (Ford Foundation). The sponsors of the Project are the New York City Board of Education, Hudson Guild Neighborhood House and Language Research, Inc., of Harvard University. Agencies cooperating in the experiment include the New York City Departments of Health and Welfare, the City Housing Authority, the New York Public Library and the Division of General Education of New York University.

In conjunction with the educational and social agencies serving the ethnically heterogeneous Chelsea neighborhood, the broad objectives of the Project are:

1. The development of techniques of instructional television utilizing minimal equipment and personnel for direct teaching, enrichment of the school program and teacher training.
2. Exploration of the effectiveness of language teaching films over television as an efficient means of teaching an adopted second language.
3. Experimenting with a community-rooted television system as a means of improving integration and participation in school and community activities.

As a first step in tying together the seven buildings that comprise the Chelsea Closed-Circuit Television Project, a

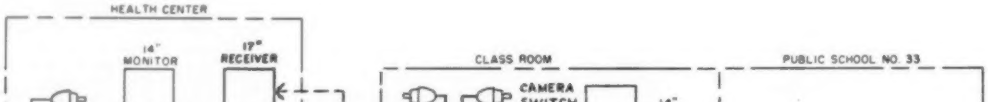


Fig. 1. Principal components of Chelsea closed-circuit TV system.

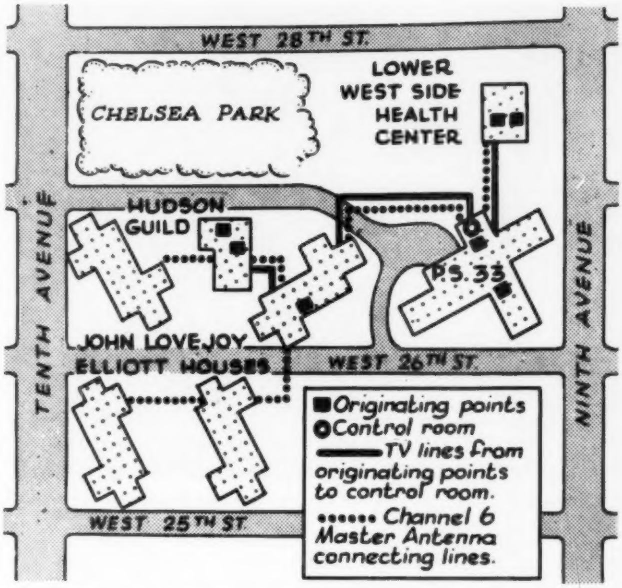


Fig. 2. Video and r-f distribution lines linking the Chelsea Project on the West Side of mid-Manhattan.

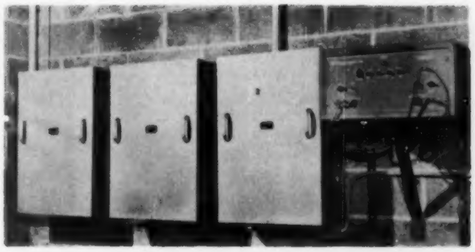


Fig. 3. Jerrold amplifier racks for master antenna system and Tel-Instrument Co. Chromatran r-f modulator.

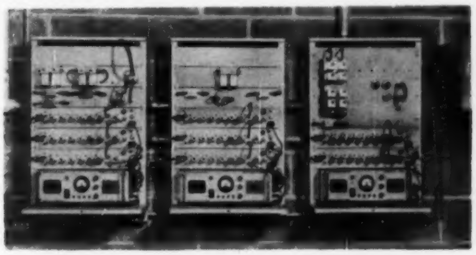


Fig. 4. Amplifier racks with covers removed.

Jerrold Electronics master antenna system was installed to provide reception on TV channels 2, 4, 5, 6, 7, 9, 11 and 13 in every apartment in Elliott Houses; in 42 classrooms in the school; in eight viewing locations at the Hudson Guild; and in two locations in the Health Center. Simultaneously with the r-f distribution lines, video and audio lines were installed from two locations at Hudson Guild, one in Elliott Houses, two in the Health Center and two in the school, making it possible to originate programs from seven different points (Fig. 2).

Seven yagi antennas were installed on the roof of one of the apartment buildings, with clear line of sight to the TV broadcast transmitters atop the Empire State Building. From the roof the broadcast signal is carried by coaxial cable to a room in the apartment house basement that contains three Jerrold amplifier racks and a Tel-Instrument Co. Channel 6 Chromatran for converting video and audio to an r-f signal (Fig. 3). A second TIC modulator has also been installed as a standby.

As seen in Figure 4, showing the covers removed, Channels 2, 4 and 5 are in the lefthand rack along with power for the three strips. The traps and pads at the top are used to cut sound level on Channel 5 to permit use of Channel 6 in the same system. Channels 7, 9 and 11 are located in the center rack, which also has its own power supply. Channels 13 and 6 are in the right-hand rack, together with a bandpass filter for the Channel 6 strip.

The master control room for the operation of the closed-circuit system on Channel 6 was built into a supply room in the basement of the school. Since cost was a significant factor, much of the equipment was arranged by General Precision Laboratory engineers to be built into existing shelves: monitors, three-channel audio mixer, audio patch panel, video switcher, four camera switcher extensions, film chain remote controls and a four-camera switching and shading unit (Figs. 5–8).

Separately mounted is the portable film chain consisting of a Bell & Howell Projector with TV intermittent action; a 35mm slide projector; a 16mm film strip projector; vidicon camera and camera control unit; and the necessary lenses and mirror multiplexers. A small VU meter has been added to the audio output of the projector, which facilitates feeding the

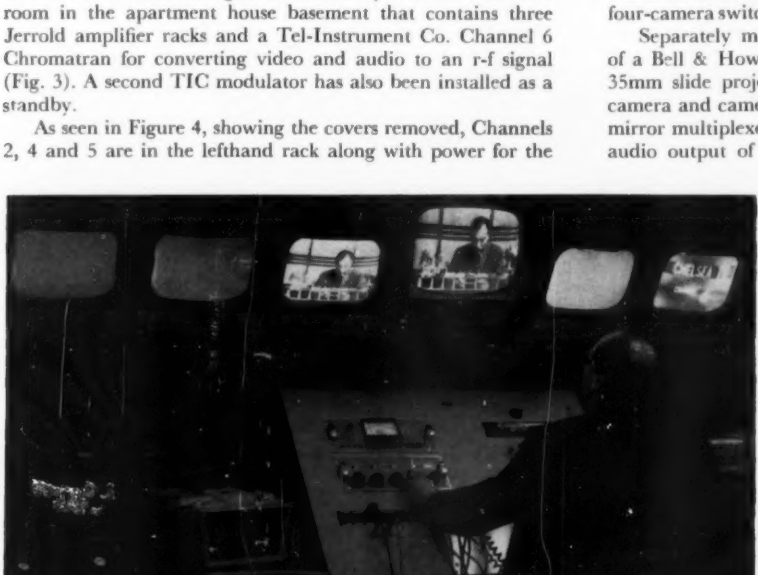


Fig. 5. Master control panel built into storage shelves, with single monitors for output of each program origination point.

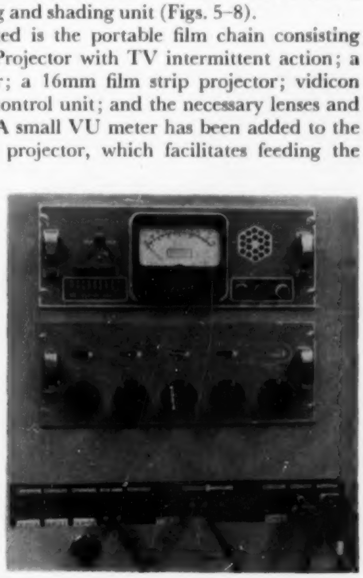


Fig. 6. Close-up of master audio control. Patch panel permits one four-channel mixer to amplify both high and low impedance inputs from several locations.

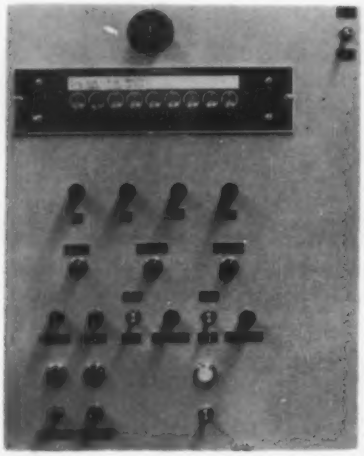


Fig. 7. Video switching, film chain remote controls, and four-camera switcher extensions.

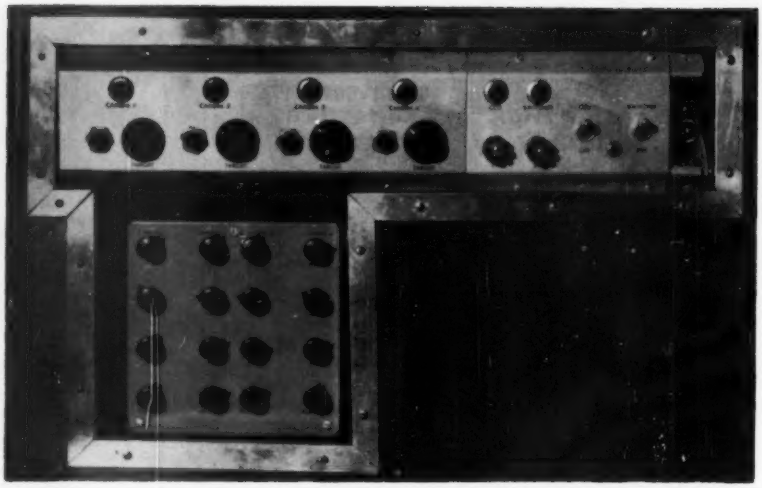


Fig. 8. Four-camera shading unit with controls for target, electrical focus, gain, beam and blanking.

film audio directly to the line, thereby freeing the Magnasync mixer for auditioning while a film is being telecast (Fig. 9).

Two flights up from the control room, a classroom was converted to studio use by the addition of acoustic tile to the ceiling, monk's cloth curtains for the walls, extra a-c capacity for lighting and air-conditioning, and overhead Mobilrail (Century Lighting) for suspension of lights and cameras. Four GPL industrial vidicon cameras can be mounted on small camera tripods and one CECO tripod dolly. After some experimentation, adjustable mountings were designed to permit suspending two of the cameras from rollers set on the overhead rail (Fig. 10). This made it possible to clear the floor of some camera cable while still maintaining a reasonable degree of camera mobility.

Available lenses are 16mm, 26mm, 50mm, 100mm and a 17 to 70mm Berthiot Pan Cinor zoom. Four Bolex lens extensions make possible extreme close-up work. However, only one lens is available per camera at one time: there are no lens turrets. Moreover, the cameras have no viewfinders. Focusing and lens adjustment can be observed only through a single studio video monitor. Once a lesson or program has begun, there can be no previewing.

The studio lights and two cameras are suspended by rollers from four longitudinal and eight transverse I-shaped aluminum rails. Thus suspended, any light can be moved four or five feet in almost any direction by a simple shove with a window pole. This helps provide lighting flexibility within a modest lighting budget (Fig. 11).

The studio was designed so that a single teacher could, as a matter of course, set up her own lights and visuals and do her own camera switching during a lesson (Fig. 12).

Camera switching can be done in either the control room or the studio. When set up for teacher operation, the cameras are switched by means of a small console that sits on the demonstration table, desk or piano (Fig. 13). In addition to one pushbutton and neon light for each camera, the console also has an emergency light and an audio jack which can feed program audio, intercom or both.

Astatic or Electrovoice lavalier microphones are used for instructional programs originating from the school. In the classroom, the teacher is at work right along with the pupils, with, for example, a filmed lesson in conversational English for Puerto Rican children. The technique employed in the language lessons is the Language Research, Inc., graded direct method, as adapted from *English Through Pictures* by I. A. Richards and Christine Gibson, of Harvard (Fig. 14).

Each of the forty-two classrooms in the school, as well as the principal's office and the studio, has a 21-in., standard production model Admiral TV receiver, the only adaptation being a grounded, three-terminal a-c lead.

When it is desirable to do large group viewing of television programs, a GPL PB611A large-screen projector is used in the school auditorium (Fig. 15). Its optical system provides a 9 by 12-ft picture from either r-f or video input, at a throw distance of 23 ft. For in-service training courses, up to 250 people can be accommodated in the auditorium. Two roving talk-

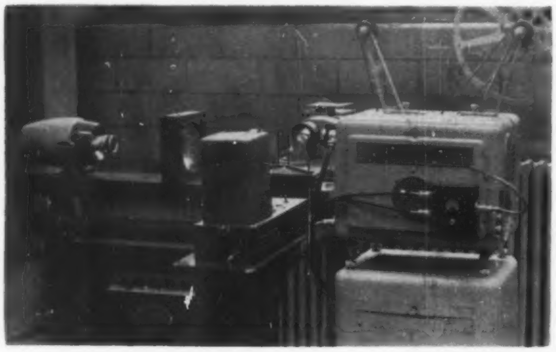


Fig. 9. Film chain with vidicon camera, multiplexer, 16mm film strip projector, 35mm slide projector and Bell & Howell 16mm film projector. Film chain shading unit is at lower left.

Fig. 10. Community program in P.S. 33 studio featuring the Hudson Guild basketball club. Lights and two cameras ares uspended from overhead Mobilrail. Camera on tripod is using zoom lens.

Fig. 11. Close-up of overhead Mobilrail light suspension.

Fig. 12. P.S. 33 music teacher switches cameras during a TV lesson. Camera at left shows close-up of notation.

back microphones connected to the school's public address system permit asking questions of the lecturer in the studio (Fig. 16).

One of the remote points from which programs can be originated is the Dental Clinic of the Lower West Side Health Center (Fig. 17). Here no equipment is permanently installed. Two portable cameras and camera control units are set up, with a homemade video switch. Three microphones can be used with a remote audio amplifier; or one microphone can be fed directly to the control-room amplifier. A second audio line is available for talkback.

Fig. 13. Four-camera switcher used by the teacher. Audio jack permits intercommunication with the control room.

Fig. 14. "He is *there.*" Simple conventional forms are used to represent relation in time and space in *English Through TV* filmed lessons. Pupils in non-English-speaking orientation class repeat sentences after the model voice on film. The teacher takes an active role in utilization of Channel 6 lessons. Standard 21-in. model Admiral receiver is typical of installation in 42 classrooms.

Fig. 15. The GPL PB611A large-screen projector enlarges pictures from either r-f or video output.

Fig. 16. A teacher-training session in the auditorium of P.S. 33. Instructor on screen is listening to questions from the audience fed through roving microphones connected to the school's public address system.

Fig. 17. A West Side Health Center program on the care of teeth originates from the Dental Clinic.

The remote setup at the Hudson Guild Neighborhood House is somewhat more elaborate, with overhead lighting on Mobilrail and four cameras on tripods available in a part-time studio. Here, too, acoustic ceiling, curtains and air-conditioning have been installed. Switching and video and audio control are done on the scene instead of in the control room, making it a fairly self-contained unit dependent on the control room only for film chain, turntable and tape recorder (Fig. 18).

In their homes in Elliott Houses, residents of the neighborhood can tune in to a varied program five days a week — ranging from lessons that their children are getting on television, to discussions with local political candidates, to a teenage dance program or to language instruction in Spanish and English.

Evaluation is being carried on at two levels: by the Board of Education's Bureau of Educational Research and Statistics for the in-school phase of the program; and by an independent organization, International Research Associates, for the community side.

While definitive evaluation from the standpoint of educational effectiveness is not yet available, it has been demonstrated that a minimal closed-circuit system can be established and operated at a fraction of the costs traditionally associated with television. This may have important implications for the use of such a system as a medium of communication within a neighborhood, much as the local weekly newspaper is used. It may have future implications for a more efficient audio-visual program within a school or a cluster of schools. It shows a way to the greater sharing of special teaching skills within a school while still avoiding the scheduling inflexibility imposed by *broadcast* instruction. And it suggests a new means of breaking through communications barriers wherever there is a high concentration in a small area of people with a hard core educational or cultural problem.

Fig. 18. A Spanish-language program from the Hudson Guild studio. Audio amplifier, video monitor, oscilloscope and rack-mounted camera control and shading units are shown.

motion-picture standards

Proposed American Standards

Proposed American Standards Specifications for Video Magnetic Tape Leader, PH22.115, and Dimensions for 2-in. Video Magnetic Tape Reels, PH22.116, have been approved by the Video Tape Recording and Standards Committees. The standards are published here for a three-month period of trial and criticism.

All comments should be addressed to Society Headquarters, attention of J. Howard Schumacher, Staff Engineer, prior to February 15, 1960. If no adverse comments are received, the proposals will then be submitted to ASA Sectional Committee PH22 for further processing as American Standards.—*J.H.S.*

Revision of American Standard

PH22.60-1959, a revision of American Standard PH22.60-1948, reaffirmed 1953, Theater Sound Test Film for 35mm Motion Picture Sound Reproducing Systems, was approved by the American Standards Association, Incorporated, on September 28, 1959.

The standard was approved by the Society's Sound and Standards Committees and ASA Sectional Committee PH22. Since PH22.60-1959 reflects no technical change from the version published in the November 1948 Journal, it is not being published here. The changes involve (a) substitution of "record" for "track" in section 2.1, (b) updating of references and (c) correction of Note to indicate that the Society no longer supplies the test film made in accordance with the standard.

The standard may be obtained from the American Standards Association, Incorporated, 70 East 45 St., New York 17, at a nominal cost.—*J. Howard Schumacher*, Staff Engineer.

Proposed American Standard

Specifications for Video Magnetic Tape Leader

PH22.115

1. Scope

1.1 This standard specifies the audio and video information that is recorded on the synchronizing leader for television video tape recordings.

2. Alignment Signal

2.1 At the head end of the tape, at least 90 sec of composite test pattern or equivalent shall be recorded at the level and under the same conditions of equipment adjustment used for video program material.

2.2 Simultaneously, a reference level audio tone in the 400- to 1000-cps range shall be recorded under the same conditions of equipment adjustment used for audio program material.

3. Identification Information

3.1 Visual identification information shall be recorded for at least 10 sec, and shall terminate at least 10 sec ahead of the start of program material. The identification shall contain, as a minimum:

(1) Program title
(2) Identification number
(3) Date of recording
(4) Length (minutes and seconds) of recording
(5) Recording studio name

4. Cue Signals

4.1 Audio cue signals, as described below, shall be recorded on the audio program track following the above visual identification signal.

(1) The audio cue signals shall consist of a 400- to 1000-cps burst of 1/5-sec duration, occurring as a minimum at 9, 8, 7, 6, 5, 4, 3 and 2 sec ahead of the program. The recording level shall be as defined in 2.2.

(2) In addition, a steady component of the audio cue tone shall be recorded approximately 20 db below the level used in (1) above, starting with the first tone burst and ending with the last one to leave a 2-sec completely silent interval before the start of program material.

4.2 A visual cue signal or sync (or sync and setup) only shall be recorded during the entire period of the steady component of the above described tone burst. Sync (or sync and setup) only shall be recorded during the 2-sec interval from the end of the tone burst to the start of program. The recording level shall be as defined in 2.1.

NOTES

1. It is desirable that the sync signal applied to the video tape leader be the same signal and from the same source as that used with the material following the leader.

2. If a visual cue signal is used, it is recommended that it be a numerical readout coincident with and identifying the audio tone burst in 4.1 (1).

NOT APPROVED

Proposed American Standard

Dimensions for 2-in. Video Magnetic Tape Reels

PH22.116

1. Scope

1.1 This standard specifies the dimensions of reels designed to accommodate the maximum standard thickness of 2-in. wide magnetic tape for television recording in maximum capacities of 1,650, 3,600, 5,540 and 7,230 ft.

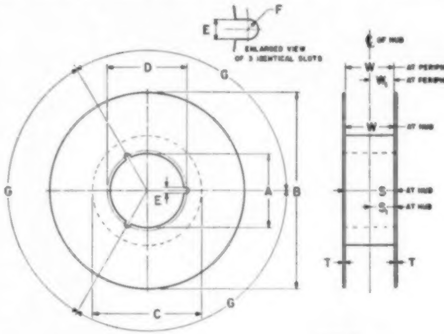
2. Reel Dimensions

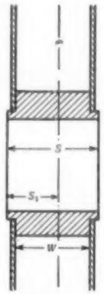
2.1 The dimensions of the reels shall be as specified in the diagrams and tables.

2.2 Flange-fastening members shall be flush or below the outer surface of the flanges.

2.3 The hub concentricity is with respect to the center axis.

2.4 The flange concentricity is with respect to the hub center axis.





HUB DETAIL

TABLE 1

Dimension	Inches	Millimeters	Degrees
A	3.000 + 0.004 − 0.000	76.20 + 0.10 − 0.00	—
C	4.50 ± 0.10*	114.3 ± 2.5*	—
D	3.250 ± 0.002	82.55 ± 0.05	—
E	0.219 + 0.006 − 0.000	5.56 + 0.15 − 0.00	—
F	0.109 + 0.003 − 0.000	2.77 + 0.08 − 0.00	—
G	—	—	120 ± 0.1
S, at hub	2.212 ± 0.003	56.17 ± 0.08	—
S_1, at hub	1.106 ± 0.0015	28.086 ± 0.038	—
T	0.091 min	2.31 min	—
W, at periphery	2.013 + 0.021 − 0.000	51.12 + 0.53 − 0.00	—
W_1, at periphery	1.007 + 0.010 − 0.000	25.578 + 0.254 − 0.000	—
W, at hub	2.020 ± 0.001	51.30 ± 0.03	—
Hub concentric within	0.002 TIR†	0.05 TIR†	—
Flange concentric within	0.020 TIR†	0.50 TIR†	—

* Maximum taper on hub outside diameter is 0.0002 per inch (0.005mm) † Total indicator reading

NOT APPROVED

TABLE 2

Maximum capacity* Feet	Maximum capacity* Meters	Maximum playing time in minutes at 15 inches (38.1 centimeters) per second	Dimensions	Inches	Millimeters
1,650	503	22	B, nominal	8.00	203.2
			max	8.01	203.4
			min	8.00	203.2
3,600	1,097	48	B, nominal	10.50	266.7
			max	10.51	267.0
			min	10.50	266.7
5,540	1,689	74	B, nominal	12.50	317.5
			max	12.51	317.7
			min	12.50	317.5
7,230	2,203	96	B, nominal	14.00	355.6
			max	14.01	355.8
			min	14.00	355.6

* Maximum capacity is based on a minimum distance of 3/16 in. (4.762mm) from the reel periphery to the tape stack, utilizing maximum thickness tape.

APPENDIX

(This Appendix is not a part of Proposed American Standard, Dimensions for 2-in. Video Magnetic Tape Reels, PH22.116, but is included to facilitate its use.)

The nominal value for W was chosen to provide proper lateral clearance for the tape, which has a maximum width of 2.000 in. The channel is narrow enough to prevent excessive lateral displacement of the tape as it is wound. Too wide a channel is likely to cause uneven winding resulting in damage to the tape edges when the reel is removed from the machine, due to deformation of the flanges.

Dimension W can be maintained at the hub, but control becomes more difficult as the flange diameter increases. Therefore, at the periphery, the tolerances on W have been increased to allow for out of flatness of the flanges.

Dimension W_1 has been included to prevent excessive curvature of the flanges. Without this dimension it would be possible for both flanges to be curved in the same direction and yet still be parallel, which would result in interference between the tape edge and the inside edge of the flange.

Trade marks or any other configurations on the flanges should be engraved rather than embossed so that there are no projections on either side.

The outside diameters of the flanges, B, will give reels the capacities suggested in Table 2. These capacities should be regarded as a maximum.

It is recommended that both flanges have air escape holes. If provided, these holes should extend to the hub periphery and be of such a size at this point as to facilitate easy threading.

PH22.116—NOT APPROVED

news and reports

International Congress 5th on High-Speed Photography 1960 SMPTE

October 16–22, 1960, Sheraton Park Hotel, Washington, D.C.

A BRIEF work-in-progress report on plans and arrangements for the Fifth International Congress on High-Speed Photography will be published in the *Journal* at frequent intervals. These brief reports are planned to be as informative as possible, serving the dual purpose of providing reference material, such as addresses, etc., and also offering a glimpse of the manifold activities which are preliminary to and an essential part of an international event of this kind. A report on the appointments of Congress Chairmen and Delegates was published in the September 1959 *Journal* (p. 638).

In October, pp. 706 and 711, the Resolution as passed by the U.S. Senate was published in full. The Resolution noted the history of four preceding High-Speed Congresses, described at some length the peacetime uses of high-speed photography and endorsed the Fifth Congress by calling upon all interested agencies of the U.S. Government to participate actively to the greatest practicable extent.

Since then the appointment of Topic Chairmen has gone forward. Listed below are names and addresses of Topic Chairmen whose appointments had been confirmed at the time this issue of the *Journal* was printed.

Topic Chairmen

These Chairmen are appointed to see that their subject area is properly represented by papers regardless of geographic origin. They serve under:

RICHARD O. PAINTER, Associate Papers Program Chairman,
General Motors Proving Ground, Milford, Mich.

ILLUMINATION — Continuous Sources: *Willett R. Wilson*, Photo Lamp Dept., Westinghouse Electric Co., Bloomfield, N.J.

———Electronic Flash and Other Intermittent Sources: *Harry Parker*, American Speedlight Co., 116–37 Farmers Blvd., St. Albans 12, N.Y.

CAMERAS — Low Repetition Rate (Intermittent and Non-intermittent): *Guy H. Hearon, Jr.*, Benson-Lehner, 5338½ Ben Ave., N. Hollywood

———Medium Repetition Rate (Rotating Prism and Other): *John H. Waddell*, 33 Loretta Dr., Syosset, Long Island, N.Y.

———Ultra High Speed (Image Dissection, Image Convertor, Mechanical-Optical, Streak): *Morton Sultanoff*, Ballistic Research Labs, Aberdeen Proving Ground, Maryland

TECHNIQUES — Schlieren and Interferometric: to be appointed.

———Inertialess Shutter and Image Convertor: to be appointed.

———X-Ray (For Use With Commercial Rotating Prism Cameras and All Other Misc. Techniques): *John H. Waddell*, 33 Loretta Dr., Syosset, Long Island, N.Y.

RECORDING MATERIALS AND PROCESSING — Photographic Emulsions: *John Niemeyer*, Eastman Kodak Co., 343 State St., Rochester, New York

———Magnetic Tape — Developments: to be appointed.

DATA REDUCTION — Film Readers (Automatic and Manual): *D. B. Prell*, Benson Lehner, 11930 West Olympic Blvd., Los Angeles 64, Calif.

———Interpretation of Streak and Other Records: to be appointed.

CAMERA ACCESSORIES AND INSTRUMENT AIDS — Optics and Lenses: *Loren E. Steadman*, Convair Astronautics, 3137 Nile St., San Diego, Calif.

———Timing and Control: *Glenn Jones*, Boeing Aircraft, 4645 Van Nuys, Van Nuys, Calif.

APPLICATIONS — Nuclear Explosion Tests: *Charles Wyckoff*, 69 Valley Rd., Needham 92, Mass.

———Ballistics and Explosives: *Morton Sultanoff*, Ballistic Research Labs, Aberdeen Proving Ground, Maryland

———Biology and Medicine: to be appointed

———Commercial Product Development: *William G. Hyzer*, 300 W. Milwaukee, Jamesville, Wis.

———Machine Analysis: to be appointed.

———Fluid Flow: to be appointed.

———Aircraft and Missile Development; *Robert M. Betty*, Lockheed Aircraft Corp., Optical Instrumentation Unit, Satellite Systems Test Services, P.O. Box 504, Sunnyvale, Calif.

———Government Research and Development (Navy): *Wm. C. Griffin*, U.S. Naval Ordnance Test Station, Box 532, Ridgecrest, Calif.

———Government Research and Development (Army and Air Force): *Lincoln L. Endelman*, 474 Naish Ave., Cocoa Beach, Florida

Exhibit and Demonstrations

Since an important function of these international meetings is the opportunity they present for registrants to examine new equipment designed for their needs considerable emphasis is being put on arranging an orderly and useful Exhibit. An Exhibit Committee, now being formed, will endeavor to give manufacturers in the U.S. and abroad a chance to display new products and demonstrate new electronic, optical and mechanical techniques and applications in photographic instrumentation. Besides the industry displays, there are expected to be exhibits and demonstrations by the U.S. Government and other governments participating. For the present, inquiries about how to participate in the Exhibit should be directed to SMPTE headquarters, 55 West 42 St., New York 36.

In charge of all local arrangements, staging the Congress, is *Byron Roudabush* of Byron Motion Pictures, Inc., 1226 Wisconsin Ave., Washington 7, D.C.

Chairman of the Congress is *Max Beard*, Naval Ordnance Laboratory — Address: 10703 East Nolcrest Dr., Silver Spring, Maryland.

Preliminary Author Forms are available from Chairman Beard, other papers chairmen, and from SMPTE Headquarters.

Papers Program, 87th Convention, May 2–7, 1960, Ambassador Hotel, Los Angeles

The Theme is: **New Techniques for Films, Television and Video Tapes** — somewhat broader in scope than that of recent preceding Conventions. The themes of the 85th and 86th Conventions explored the relationship of the Society's interests to certain aspects of the astonishing world we live in. The 87th Convention will survey the new (and in some instances revolutionary) techniques that have been developed or invented in response to the changing needs of the industry.

87th Convention Program Chairman: **Herbert E. Farmer,** c/o Cinema, Univ. of Southern Calif., University Park, Los Angeles 7

Author Forms must be submitted by Topic Chairmen by February 15, 1960. No papers will be accepted after this date except by special agreement of the Program Chairman or of the Papers Committee Chairman.

TOPICS AND TOPIC CHAIRMEN

Acoustics and Architecture of Studios and Stages: **Frank E. Pontius,** Westrex Corp., 6601 Romaine St., Hollywood 38

Films in Industry: **Julian Ely,** Autonetics, Dept. 368, 9150 E. Imperial Highway, Downey, Calif.

Laboratory Practices: **Edward H. Reichard,** Consolidated Films Industries, 959 Seward St., Hollywood 38

New Photographic Materials: **Vaughn Shaner,** Eastman Kodak Co., 6702 Santa Monica Blvd., Hollywood 28

Optics and Images: **Alan M. Gundelfinger,** Technicolor Corp., 6311 Romaine St., Hollywood 38

Sound Recording and Reproduction: **Edward P. Ancona, Jr.,** Motion Picture Research Council, 6660 Santa Monica Blvd., Hollywood 38

Space Age Motion Pictures and Television: **Lloyd T. Goldsmith,** Ramo-Wooldridge Laboratories, 8433 Fallbrook Ave., Canoga Park, Calif.

Television — Equipment and Practices: **Theodore B. Grenier,** American Broadcasting Co., 4151 Prospect Ave., Hollywood 27

Television — Recording: **Ralph E. Lovell,** 2554 Prosser Ave., Los Angeles 64

Training Personnel for Television and Motion Pictures: **Robert W. Wagner,** Dept. of Motion Pictures, Ohio State Univ., Columbus 10, Ohio

Note to Authors: Author Forms must be in the hands of the Program Chairman on or before February 15, 1960 (as noted above). This means that in all fairness to Topic Chairmen, Authors must submit Author Forms to the appropriate Topic Chairman as far in advance of that date as possible. Papers which do not readily fit under any topic or which may seem unrelated to the Convention Theme may be submitted directly to the Program Chairman. It should also be noted that papers accepted for presentation at the Convention are not thereby automatically accepted for publication in the *Journal*. Although most Convention papers are eventually published in the *Journal*, a paper suitable for oral presentation is not necessarily suitable for publication.

General Comment: Each of the 10 Topics listed above deals with timely and important developments. Some additional comment may serve to clarify the scope and significance of certain topics.

Acoustics and Architecture of Studios and Stages: The increase in production for television together with changes in budgets and schedules has placed new emphasis on quality and convenience and created new problems of acoustical treatment, ventilation, heating methods and noise.

Films in Industry: "In-plant" film production is an important part of many industries. That part which relates to operations and company relations is the program of the Industry Film Producers Association, but the part common to all production, techniques and facilities, is within the Society's area of interest and becomes its problem.

Television — Recording: The scope of this topic includes handling techniques such as splicing, editing, cuing, leaders, slates and storage. These techniques are in a constant state of change and development. This topic also covers problems of transfers — tape to film and film to tape.

Training Personnel for Television and Motion Pictures: It is time the industry faces the problem of the education of future personnel of the television and motion-picture industries as well as the immediate training of technicians to new techniques.

89th Convention—Toronto

International Achievements in Motion Pictures and Television is the theme of the 89th Convention to be held in the Spring of 1961 in Toronto. Committee appointments confirmed to date include: Gerald G. Graham, National Film Board, Montreal, *Chairman, Toronto Planning Committee;* Kenneth S. Oakley, Bell & Howell Canada Ltd., *Chairman,* and Peter Elliott, S. W. Caldwell Ltd., *Assistant, Exhibits and Customs Committee;* Harold Bibby, Canadian Kodak Co., *Hotel Arrangements;* Rodger Ross, Canadian Broadcasting Corp., *Program Chairman;* and Ralph Ellis, Freemantle of Canada, in charge of *moton-picture short subjects.* The Toronto Planning Committee has already held a number of meetings and preliminary arrangements are under way. One of the initial steps has been consultation with representatives of foreign embassies in Ottawa as to means of encouraging participation by the various countries.

SMPTE Elections

Results of the 1959 elections were announced at the 86th Convention. Officers elected (or re-elected) for the 1960–1961 term are: Deane R. White, *Engineering Vice-President;* Ethan M. Stifle, *Financial Vice-President;* Garland C. Misener, *Sections Vice-President;* and G. Carleton Hunt, *Treasurer.* Six *Governors* were elected: (East Coast) Charles W. Wyckoff and D. Max Beard: (Central) Malcolm G. Townsley and W. W. Wetzel; (West Coast) Herbert E. Farmer and Edward H. Reichard.

Section Officers and Managers elected are:

ATLANTA: Chairman, Alva B. Lines; *Secretary-Treasurer,* Wesley R. Sandell; *Board of Managers,* Wilkes Straley, Durward R. Thayer and Charles W. Wood.

BOSTON: Chairman, Edward H. Rideout; *Secretary-Treasurer,* Robert M. Fraser; *Board of Managers,* Bruce Harding, Joseph Rothberg and Joseph Dephoure.

CANADA: Chairman, Findley J. Quinn; *Secretary-Treasurer,* Harold Green; *Board of Managers,* L. T. Wise, Leon R. Terry, Chester E. Beachell and R. S. Rekert.

CHICAGO: Chairman, William H. Smith; *Secretary-Treasurer,* Philip E. Smith; *Board of Managers,* Allen Hilliard, Mervin LaRue and William D. Hedden.

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- *Scientifically compounded curve of light gate—prevents film buckle.*
- *Single blade, double speed conical shutter, providing highest light transmission of any projector. Leading and trailing edges have integral air scoops that aid in dissipating heat.*
- *Rollers, drums, sprockets and film gate made from non-magnetic materials—eliminates possibility of magnetic sound track damage and necessity for frequent degaussing. Dual sprockets on all shafts machined of hardened aluminum alloy. No sprocket change required when changing from 70mm to 35mm or vice versa. (Less than 4 minutes required.)*
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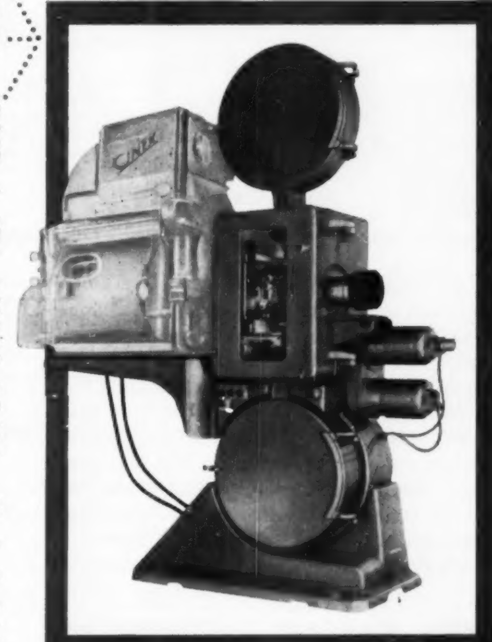

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Dallas, Tex.	Tower Theatre
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Dayton, O.	Hunt's McCook Theatre
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Ft. Wayne, Ind.	Clyde Theatre
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Hollywood, Cal.	Carthay Circle Theatre
Hollywood, Cal.	Egyptian Theatre
Honolulu	Kuhio Theatre
Houston, Tex.	Tower Theatre
Houston, Tex.	Uptown Theatre
Indianapolis, Ind.	Lyric Theatre
Jacksonville, Fla.	Five Points Theatre
Kansas City, Mo.	Capri Theatre
Little Rock, Ark.	Capitol Theatre
Lexington, Ky.	Strand Theatre
Louisville, Ky.	Brown Theatre
Miami Beach, Fla.	Loew's 170 St. Theatre
Miami Beach, Fla.	Sheridan Theatre
Milwaukee, Wis.	Strand Theatre
Minneapolis, Minn.	Academy Theatre
Upper Montclair, N. J.	Bellevue Theatre
Montreal, Canada	Alouette Theatre
New Orleans, La.	Panorama Theatre
New York, N. Y.	Criterion Theatre
New York, N. Y.	Loew's State Theatre
New York, N. Y.	Rivoli Theatre
New York, N. Y.	Warner Theatre
Oklahoma City, Okla.	State Theatre
Omaha, Nebr.	Cooper Theatre
Philadelphia, Pa.	Boyd Theatre
Philadelphia, Pa.	Goldman Theatre
Philadelphia, Pa.	Midtown Theatre
Phoenix, Ariz.	Vista Theatre
Pittsburgh, Pa.	Nixon Theatre
Pittsburgh, Pa.	Warner Theatre
Portland, Ore.	Broadway Theatre
Providence, R. I.	Elmwood Theatre
Richmond, Va.	Willow Lawn Theatre
Rochester, N. Y.	Monroe Theatre
Sacramento, Calif.	Alhambra Theatre
Salt Lake City, Utah	Villa Theatre
San Antonio, Tex.	Broadway Theatre
San Diego, Calif.	Capri Theatre
San Francisco, Cal.	Alexandria Theatre
San Francisco, Calif.	Coronet Theatre
Seattle, Wash.	Blue Mouse Theatre
Shreveport, La.	Saenger Theatre
St. Louis, Mo.	Ambassador Theatre
St. Louis, Mo.	Pageant Theatre
Syosset, N. Y.	Syosset Theatre
Syracuse, N. Y.	Shoppingtown Theatre
Syracuse, N. Y.	Eckel Theatre
Tampa, Fla.	Britton Theatre
Toronto, Ont.	Tivoli Theatre
Tulsa, Okla.	Ritz Theatre
Vancouver, B. C.	Stanley Theatre
Washington, D. C.	Uptown Theatre
Youngstown, O.	State Theatre

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WASHINGTON, D.C.: Chairman, Howland Pike; *Secretary-Treasurer,* William E. Youngs; *Board of Managers,* Henry M. Fisher, Jack C. Greenfield and Byron Roudabush.

Education, Industry News

Awards for excellence in medical and scientific photography presented at the 29th Annual Meeting of the Biological Photographic Association held in Montreal, Aug. 31 to Sept. 3, included eight awards for motion pictures and 44 awards for still photography. Selections were made from hundreds of entries. One motion picture, *Dynamics of Phagocytosis,* received two awards, one in the Medical Education division and the other in the Professional Teaching division. The film was made with a Cine-Kodak Special II fitted with a Bausch & Lomb beam splitter. A Kodaslide 35mm projector, air-cooled and with heat filter, using a 1000-w tungsten filament lamp was used as the light source. Other films which received awards are: *Transplantation of the Embryonic Heart in the Mouse,* in the Institutional Research division; *Roundpupil Intracapsular Cataract Extraction. The Swarming of Proteus Vulgaris,* and *Craniotomy and Removal of Left Frontal Meningloma,* awarded First, Second and Honorable mention in the Institutional Teaching division, and *Fire and Explosion Hazard With Flammable Anesthetics* and *Just Four Minutes,* awarded Second and Honorable Mention in the Professional Teaching division.

The Biological Photographic Association is dedicated to the skills of medical and scientific photography. It publishes the *Journal of the Biological Photographic Association,* a quarterly publication of articles on scientific motion-picture and still photography and photomicrography in color and monochrome.

To build up communications facilities, including film and television, in underdeveloped countries Unesco has instituted a series of meetings to be held in Bangkok, Thailand, Jan. 18–30, 1960. Those attending the meeting will include representatives of 25 member states of Unesco, media experts from South-East Asia and representatives of international professional associations of press, radio, film and television. Purpose of the initial meeting is to draw up a program for South-East Asia. Later meetings are planned for Latin America (1961) and Africa (1962). The survey is being conducted for the United Nations Economic and Social Council. It is intended to enable the Council to evaluate the material, financial and professional requirements and resources needed to carry out a world-wide development program which will include training fellowships, seminars and the provision of equipment and other facilities.

Film problems that will be discussed at the Bangkok meeting will include difficulties in distribution, training of technicians and production of newsreels and other films in the smaller South-East Asian countries. In the field of television, the meeting will consider how this medium might be developed as an aid for information and education. Technical training will be given special attention.

The main block of the BBC Circular Television Center ("Europe's Biggest") will be completed early in 1960, according to the present schedule. (Some statistics: It will contain eight million bricks; 55,000 tons of concrete; 4300 tons of steel and 2500 doors, with a crew of 800 men laboring to put this vast amount of material in place).

Standing on a site of 13 acres at Shepherd Bush, London, the huge circular main block will contain seven studios and several hundred offices; a scenery block; a restaurant block; a maintenance block and eventually a "spur" or "tail" running from the main block.

The scenery block, which covers one acre, is now in use. It has workshops for the making of scenery and properties for TV stage sets, a scenery-painting studio, a 26-ft-high "setting space" where scenery is assembled and distributed to studios and storage space for scenery and properties. The block includes about 200 offices. The restaurant (scheduled for completion in 1960) will accommodate 750 persons at one sitting. It is connected to the main block by a two-story bridge and a tunnel.

The main block is a circular building covering $3\frac{1}{2}$ acres. A seven-story inner ring is built around a circular garden 150 ft in diameter. Outside this ring and radiating from it are seven ground-floor studios. A multi-story control block in the shape of a wedge is located between two of the studios. Around the outer periphery of the studios will be a runway for transporting scenery and properties from the scenery block. The inner ring, planned mainly for offices, will also contain wardrobe facilities, make-up and music departments, and a BBC club with a roof garden. The main floor and basement will contain about 120 dressing rooms with accommodation for about 550 persons.

A recent view looking west of the central multi-story control block.

The seven production studios will each have its own air-conditioning plant. The first studio (for dramatic productions) is scheduled to be in operation by mid-1960 and three more (for music, light entertainment, school and children's programs) are scheduled to begin operation late in 1961. Thirty TV cameras and associated electronic equipment have been ordered. Public audiences will be admitted to the studios for certain programs. Tiered, demountable seating will be provided in each studio according to need.

The largest studio of the remaining three to be built later will be 108 ft long, 100 ft wide and 54 ft high. It will have a $7\frac{1}{2}$-ft pit into which part of the floor can be lowered. The pit can be filled with water for possible use in aquatic programs.

Donald McMaster, Chairman of the Executive Committee of Eastman Kodak Co., has been named Honorary Fellow of the Photographic Society of America—the highest honor bestowed by PSA. The presentation ceremony took place October 10 at the PSA National Convention in Louisville, Ky. Mr. McMaster was cited for "his general service to photography, his untiring devotion to the promotion of amateur photography throughout the world, his exemplification of high ideals in the business world, and for his attainment as an exhibition photographer." A charter

member of PSA, he is the 19th person to be awarded an Honorary Fellowship since it was founded in 1933. He is a Fellow of the Society and has been active in a number of other organizations both in America and abroad. He is an Honorary Fellow and a Past-President of the Royal Photographic Society of Great Britain.

G. H. Cook, a chief optical designer of Taylor, Taylor & Hobson, a Division of Rank Precision Industries Ltd., has been presented with an award for outstanding technical services to the International Cinema Industry. The award (one of three) was presented at the International Cinematography Engineering Congress held in October in Turin. Mr. Cook is the leader of a group of scientists which has produced specially designed lenses for every phase of professional cinematography. He is the author of these papers published in the *Journal:* "35mm Camera Lenses," pp. 534–536, Aug. 1958; "Vidicon Camera Lenses," pp. 596–598, Sept. 1958; "Television Zoom Lenses," pp. 25–28, Jan. 1959.

A. J. Buxton and M. O. Felix, Canadian Westinghouse Co., are recipients of The National Electronics Conference Award for their paper, "The Performance of FM Scatter Systems Using Frequency Compression," which was presented at the 14th Annual National Electronics Conference, Oct. 13–15, 1958. Presentation was made during the Conference to the inventors for a method to improve scatter communications systems by significantly reducing undesirable noise. The scatter system is used for long-range, beyond-the-horizon transmission of voice, television, teletype, facsimile, telemetering and data signals over hops of 100 to 200 miles.

Appointment of John G. Frayne as Manager of Development Engineering at Datalab, a division of Consolidated Electrodynamics Corp. of Pasadena, Calif., has been announced. Dr. Frayne was formerly Engineering Manager of Westrex Corp., where he held a variety of engineering and administrative posts during his 30 years with the firm. Earlier he was Professor of Physics at Antioch College. A Fellow and Past-President of the Society, he is recipient of the Journal Award (1941), the Progress Medal (1947) and the Samuel L. Warner Award (1959). He received an Academy Award from the Academy of Motion Picture Arts and Sciences in 1953 for his development of intermodulation distortion measuring techniques. He is also a Fellow of the Audio Engineering Society and is recipient of the Emile Berliner Award for contributions to the development of stereophonic phonograph records.

C. C. Davis has been appointed to the engineering staff of Stancil-Hoffman Corp. of Hollywood. Formerly associated with Westrex and Western Electric Co., he is the holder of 15 U.S. patents and has made many notable contributions to the field of magnetic recording. A Fellow of the Society, he is the recipient (1956) of the Samuel L. Warner Memorial Award. He was cited for "outstanding contributions in the field of sound-recording and reproducing mechanisms." The citation mentions his development of the Davis Drive film-transport mechanism and his application of its principle to disc recording drives," and the development of a "multitrack magnetic head with extremely low cross-talk." Some of his developments have been described in papers published in the *Journal*. In his new post he will be responsible for electromechanical designs of the company's magnetic film recorders, subminiature recorders and special high-resolution magnetic heads.

Vladimir K. Zworykin has been made an Honorary Member of the British Institute of Radio Engineers. The citation, which mentions his "invention of the storage tube . . . in 1923 (and) his more recent work in promoting an international body for the further application of electronic science in the fields of biological research and diagnosis," was read on July 2, 1959, at ceremonies held in Downing College, Cambridge. On the preceding evening, July 1, Dr. Zworykin had delivered the Fourth Clerk Maxwell Memorial lecture. The lecture on "Human Aspects of Engineering Progress" dealt with electronic developments in three separate fields, Medicine, Transport and Public Affairs. He described developments in these fields and suggested electronic developments of the future.

George Lewin, Chief of Pictorial Engineering and Control Office, Army Pictorial Center, Long Island City, N.Y., has been honored by being made a Fellow of the Audio Engineering Society. The award was made "in recognition of the discovery and elucidation of the infrared transparency of magnetic recording oxides." Presentation ceremonies took place on October 8, 1959, during the AES Convention in New York. The discovery mentioned in the citation was made while Mr. Lewin was making tests at the Army Pictorial Center with magnetic-striped film on a Mil-Spec or JAN projector. Mr. Lewin, a Fellow and former Governor of the SMPTE, is the recipient of the Journal Award and the Samuel L. Warner Award, both for 1958. The Journal Award was presented for papers published in the September 1957 and December 1957 issues of the *Journal* on the infrared transparency of magnetic tracks. The Samuel L. Warner award was in recognition of the work described in these papers and other contributions in the field of recording and reproduction.

The Christopher Columbus award was presented to three RCA executives during the 7th International Congress on Communications held in October in Genoa, Italy. Recipients are David Sarnoff, Chairman of the Board; E. W. Engstrom, Senior Executive Vice-President; and V. K. Zworykin, Honorary Vice-President. Presentation was made by Giovanni Gronchi, President of Italy.

The Kenya Broadcasting Service which began operations Oct. 1 provides a unified broadcasting system for English, African and Asian programs. Four new 10-kw transmitters have been installed by Marconi's Wireless Telegraph Co., Ltd., at the main transmitting station at Langata, near Nairobi. Four older Marconi transmitters have been transferred from Cable & Wireless Ltd. which relinquished its broadcasting concession in Kenya when the new service was inaugurated.

A National Committee for High-Speed Photography has been formed in association with the Royal Photographic Society of Great Britain. Aims of the Committee as set forth in the announcement are "to provide a representative national body for dealing with international matters in the field, to organize one-day Conferences in Great Britain, to stimulate and to coordinate publication, to assist in abstracting and to disseminate information on the subject." The first Conference was held September 18. Chairman of the Committee is W. Deryck Chesterman.

Interest in high-speed photography is also reflected in the formation of a committee or study-group under the auspices of the Atomic Weapons Research Establishment, Aldermaston, Berks. A letter from Kenneth R. Coleman describing the formation of this committee states: "The Atomic Weapons Research Establishment has done a great deal of work on high-speed photography . . . . it was felt that as so much 'know-how' existed in the one place a good way of disseminating it would be by forming a committee." This committee, which, Mr. Coleman said, might also be described as a "study-group" or "working party" meets at intervals of two or three months and "is flourishing," he reports.

The second annual American Film Festival will be held April 20–23, 1960, at the Barbizon-Plaza Hotel in New York City under the sponsorship of the Educational Film Library Association whose membership is comprised of institutional audio-visual centers and related interests.

Elliott H. Kone, President of EFLA and Director of the Yale University Audio-Visual Center, has announced that all 16mm films and filmstrips released in the United States during the calendar year 1959 will be eligible for Blue Ribbon Awards and Certificates of the 1960 Festival. Thirty-four Festival competition categories are grouped under the general headings of Education and Information; Art and Culture; Religion and Ethics; Business and Industry; Health, Safety and Medicine. Those wishing to enter films may obtain detailed information and entry blanks from Miss Emily Jones, Administrative Director of EFLA, 250 West 57 St., New York 19. Entries must be filed with EFLA by midnight, Jan. 20, 1960.

A TV program, *Man in Space,* produced by the KUHT Film Production Div. of the University of Houston's Radio-TV-Film Center under a contract with the

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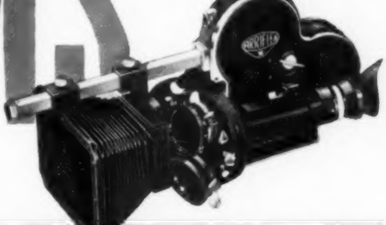

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Hughes Tool Co.
International Business Machines
International Harvester Company
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Find out why the motion picture departments of the nation's leading companies and professional film producers prefer the ARRIFLEX® 16... the world's most versatile, **money saving** production camera.

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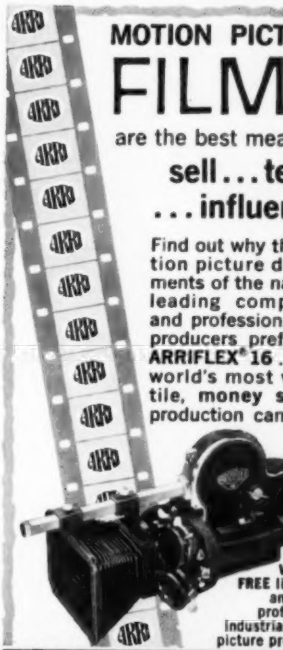

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address ....
city .... zone .... state ....

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National Educational Television and Radio Center, will be shown first on Dec. 7. Release to other educational TV stations will begin Dec. 20. The program will feature four scientists who will present a "preview" of man's first trip into space.

A closed-circuit system wired into eight classrooms of the University of California at Los Angeles is expected to solve an educational problem resulting from registrations greatly in excess of the anticipated number. Solution to the problem was brought about by Rudy Bretz, the University's Head of Educational Television. His advice was sought when more than 1800 students registered for a course in Philosophies of Today which had been planned for an enrollment of no more than 350.

The First International Congress on Medical Photography and Cinematography will be held at Cologne, Germany, Sept. 27–30, 1960, in connection with the Photokina (Sept. 24 to Oct. 2). The purpose of the Congress will be to show the present status of photographic and cinematographic techniques in medicine. Detailed information is available from the Deutsche Gesellschaft für Photographie eV, Neumarkt 49, Cologne.

A legal precedent may have been established on Aug. 11, 1959, when the presiding judge for the Los Angeles Municipal Court admitted newsfilm clips as evidence in an eviction case and permitted TV coverage of the entire trial. The court was adjourned to reconvene in the KTLA-TV studios where witnesses and attorneys were permitted to study newsfilm clips of the eviction proceedings when it was alleged, one of the families involved fought with the deputies carrying out the eviction order.

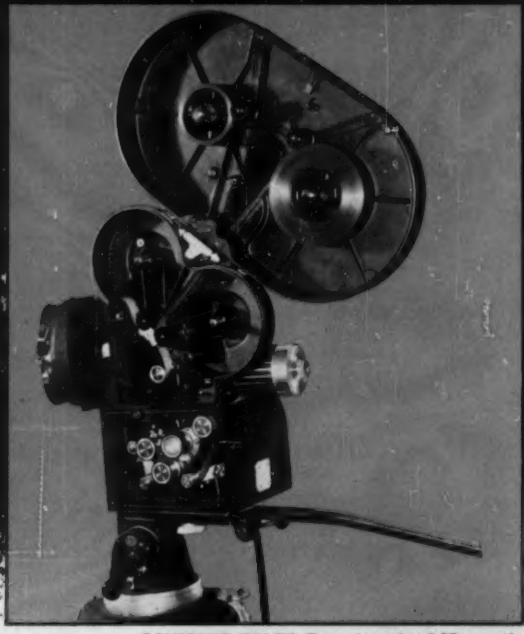
A valuable collection of sixteen Nazi-German motion-picture newsreels produced between 1940 and 1942 has been presented to the University of California, Los Angeles, Theater Arts Dept. The newsreels have a total running time of about five hours. Of the sixteen reels, approximately half have a German narration and were designed for domestic release. The remainder have a Spanish narration and were made for foreign release. A University of California research grant has been awarded to Professors Fielding, Rose and Driscoll of the Theater Arts Dept. to allow for the duplication, cataloguing and analysis of the collection.

A press conference to demonstrate a new electronic banking system designed by General Electric Co. for the Bank of America was held simultaneously in four different cities by means of closed-circuit television. The system (called ERMA for Electronic Recording Method of Accounting) uses magnetic character reading to read, sort and post an estimated 33,000 accounts per hour (about 32,755 more than the average human bookkeeper can post in the same time). The closed-circuit conference originated at the Bank of America's ERMA Center in Los Angeles and was "piped" into receiving sites in San Francisco, Chicago and New York. The new system occupies about 10,000 sq ft of space. A maze of sub-floor wiring connects all units of each system to the central computers.

An auction by TV of U.S. Defense Department surplus property including construction equipment, road building machinery, generators, trailers, machine tools and other articles was conducted by TelePrompTer Corp. on Oct. 7 over a closed-circuit system covering six cities. The sale was broadcast to viewing locations in St. Louis, New York, Chicago, Philadelphia, Boston and Columbus, from three storage depots located at the Army Engineer Depot at Granite City, Ill.; the Air Force Depot at Shelby, Ohio; and the Philadelphia Naval Shipyard. Auctioneers at each depot described and identified the material offered for sale.

Documentation, Inc., of Washington, D.C. has become a wholly owned subsidiary of Benson-Lehner Corp. of Santa Monica, Calif., under terms of a merger announced jointly by the two companies. The Washington firm specializes in data storage and retrieval.

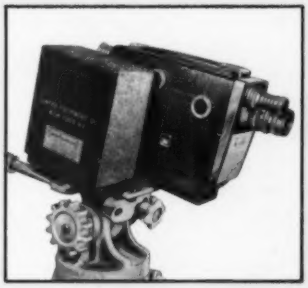
The merger with Ampex Corp. of Orr Industries became effective Oct. 7. The latter firm is now known as Orr Industries, a Division of Ampex Corp.



GAUMONT-KALEE Transistorized Magnetic Sound Attachment for ARRIFLEX 16

Converts ARRIFLEX 16 into a single system magnetic sound camera unit that's compact, lightweight, well-balanced. Unit is mounted between camera and tripod head. Transistorized amplifier. ARRI can still be used as silent camera by simply removing sound attachment.

Don't ask us to help you with the love interest. If your script needs tinkering, go to a script doctor! Feel free, however, to come to CECO* with any technical problem. Chances are we have in stock the equipment to do what you want done. If not, we'll alter or combine—even custom-build it for you. Don't bet there's any mechanical problem CECO can't solve. In addition, we sell, rent and service the finest professional photographic equipment. Your patronage is always appreciated—whether you make a major purchase or buy a bottle of film cement.

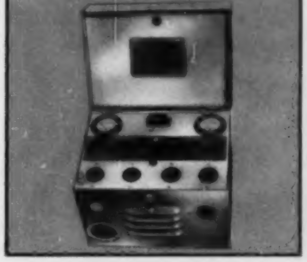


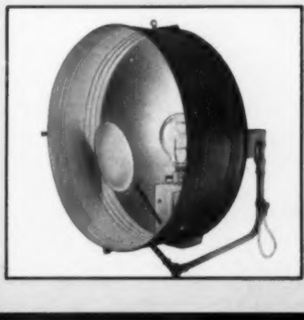
110 Volt AC Synchronous Motor for Kodak Model K-100 Camera

A fine, precision motor that drives camera at exact sound speed of 24 fps. Easy to attach, no special tools required. Synch motors for other cameras available.

Colortran Master "Chief" Converter

Has every improvement and convenience feature for motion picture work. Portable, yet large in capacity. Can be used as master control panel to set up individual line intensity variations. 30 amps from 220 volts; 45 amps from 115 volts.





CECO Cone Lights 5000 Watt —2000 Watt—750-1000 Watt

Floods large area with shadowless, soft light. Can be placed close to actors. Complete with switch, 25 ft. cable and yoke. (5000 Watt illustrated).

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Six monographs are published each year by the British Broadcasting Corp. covering certain research and development projects of its Engineering Division. Publication of the series began in June 1955 with a monograph on "The Suppressed Frame System of Telerecording." The most recent title (June 1959) is "A Quality-Checking Receiver for VHF FM Sound Broadcasting." The series is available by subscription at $3.00 a year or individual copies may be purchased at a price of 75 cents. A list of titles is available upon request from Anthony Graham, Assistant Circulation Manager, Export, BBC Publications, British Broadcasting Corp., 35 Marylebone High St., London, W.1.

Charles A. Nichols has been appointed Engineering Manager of Conrac, Inc., Glendora, Calif. Prior to his present appointment he was Vice-President in charge of Engineering of Hoffman Electronic Corp., Consumer Products Div.

Eugene B. Fleischer has been appointed chief of the Film Section of the Radio-TV-Film Dept. of the University of Miami. He succeeds C. Henderson Beal who has resigned. Mr. Fleischer has been associated with the University of Miami since 1958 when he became film editor for a series of color films, *Survival in the Sea*. Earlier appointments included Director of Motion-Picture Photography at the University of Nebraska and at Virginia Polytechnic Institute.

George T. Eaton of Kodak Research Laboratories has been re-elected President of the Society of Photographic Scientists and Engineers for a two-year term, 1959–1961. Other officers re-elected are: Steven Levinos, Ansco, Executive Vice-President; John A. Maurer, JM Developments, Engineering Vice-President; and Herbert Meyer, Motion Picture Research Council, Financial Vice-President. Newly elected officers are: R. Clark Jones, Polaroid Corp., Editorial Vice-President; and C. Graham Eddy, Medical Illustrations Div., Veterans Administration, Secretary-Treasurer. The SPSE National Conference will be held October 26–30 in Chicago.

Edwin J. Deadrick has been appointed plant manager of Audio Devices, Inc. He will be responsible for operation of the company's two subsidiaries in Stamford, Conn., The Audio Tape Corp. and the Audio Manufacturing Corp. Prior to his present appointment he was plant manager of Howard Plastics, a division of W. R. Grace.

Frederick T. Parsons has joined Filmline Corp. as Chief Engineer. He will design and supervise the manufacture of photographic equipment, primarily, color film processors. Prior to his present appointment he was Chief Engineer for Pathe Laboratories and Pathecolor, Inc. During World War II, he designed special equipment for Wright Field Air Force Base and worked on an equipment program for handling aerial gunnery and military training films.

Obituaries

Edgar Gretener

Edgar Gretener died in October of last year, in Zurich, Switzerland, at the age of 56. A Fellow of the Society, he was widely acclaimed for his work in developing the Eidophor color television projector and other scientific achievements. He was born March 3, 1902, in Lucerne. He studied electrical engineering at the Swiss Federal Institute of Technology, Zurich, which conferred upon him the degree of Doctor of Science. His professional career began in the firm, Albiswerk, in Zurich, a subsidiary of Siemens & Halske, where he became head of the Research Laboratory. In 1930 he joined the parent company in Berlin as head of the Telecommunication Laboratories, and shortly thereafter he was appointed one of the three Directors of the Central Laboratory. During the time he was in Berlin he devoted considerable work to the development of lenticular film for color photography, a project that was later abandoned in favor of a different method, still under development at the time of his death.

Shortly before World War II he returned to Switzerland after having refused to

work on military projects in Germany. He resumed his work with Albiswerk where he remained until 1943 when he founded his own firm, the Dr. Edgar Gretener A. G., to give greater scope for the development of his ideas. His main interests were in the fields of optics and illumination and at the time of his death he was engaged in a number of projects which were nearing completion.

Louis Philippe Clerc, distinguished pioneer of photography, died at his home in Paris, Sept. 7, at the age of 84. Author of a number of books on photography, he was editor of the French scientific photographic publication, *Science et Industries Photographiques.* During World War I he was awarded the Croix de guerre for his services in aerial photography and in 1949 he was made a Chevalier de la Legion d'honneur for his work in the practical application of the photographic science to industry. A detailed biography of M. Clerc by Glenn E. Matthews appeared in the August 1955 issue of the *Journal* (p. 460).

John H. Kliegl, cofounder and President of the Kliegl Brothers Universal Stage Lighting Co, of New York, died Sept. 30, 1959, at the age of 89. With his brother, the late Anton Kliegl, he made motion-picture history by inventing (about 1911) the klieg light, a carbon-arc light that made possible indoor motion-picture photography. His company, which was founded in 1896 supplied lighting and stage effects for many of the "greats" of stage and screen. He was born in Bad Kissingen, Bavaria, and came to this country in 1888. He first worked as a locksmith and studied electricity at night at the American Institute of the City of New York.

current literature

The Editors present for convenient reference a list of articles dealing with subjects cognate to motion-picture engineering published in a number of selected journals. Photostatic or microfilm copies of articles in magazines that are available may be obtained from The Library of Congress, Washington, D.C., or from the New York Public Library, New York, N.Y., at prevailing rates.

American Cinematographer vol. 40, Aug. 1959

Photography Sharp, Clear, and Incisive (p. 480)
Directional Continuity in Cinematography, Pt. 2 (485) *J. V. Mascelli*
Shooting Black and White in Color (p. 486) *H. A. Lightman*
Simultaneous Switching (p. 448) *R. Zeper*
Product Report on the Perfectone Tape Recorder (p. 492)

vol. 40, Sept. 1959

Color in Motion Pictures and TV Part I: The three-color theory (p. 542) *R. A. Mitchell*
Motion Picture Cameras; Auricon Cine-Voice (p. 548)
Electrical Tripping Mechanism for Sound Mixing (p. 552) *R. W. Moore*
Exposure Accuracy with Magic-Eye Cameras (p. 556) *D. Norwood*

British Kinematography vol. 34, June 1959

Lighting for Film and Television Studios; The Silent Film (p. 152) *B. Honri*
Lighting for Sound Films (p. 157) *T. E. Knight*
Lighting for Television Studios (p. 162) *R. de B. McCullough*

International Projectionist vol. 34, July 1959

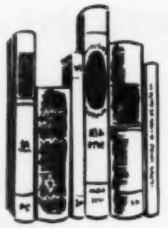
Screen-Light Requirements in Modern Projection (p. 5) *R. A. Mitchell*
The Videotape Recorder (p. 9) *G. B. Goodall*
35/70-mm All-System Projector by National Theatre Supply (p. 12)

Kino-Technik vol. 13, July, 1959

Sterophonie im Film—echte und Pseudo-Verfahren (p. 166) *W. Grau*
Sterophone-Anlage für sechs und vier Kanäle (p. 175) *W. Pahl*

vol. 13, Aug 1959

Der Schmalfilm in der wissenschaftlichen Filmarbeit (p. 207) *Dr. Bekow*
Hochfrequenzkinematographie in der Drucktechnik (p. 211) *K. Wagenbauer*
Mikrokinematographie aus der Praxis gesehen (p. 213) *H. A. Traber*
Wissenschaftliche Tierfilme mit der Schmalfilmkamera (p. 215) *O. Koenig*
Dokumentarische Filmaufnahme in der Zahnheilkunde (p. 219) *T. Jung*
Sichere Klebestellen durch vollautomatische Klebemaschinen (p. 222)



books reviewed

Calcul des Combinaisons Optiques

By Henri Chrétien. Published (1958) by Librairie Du Bac, 92 Rue Du Bac, Paris VII, France. 862 pp. Illus. 6¼ by 9¼ in. Price $20.00.

This posthumous edition is now the final, authoritative record of Chrétien's classic work. The man has become an immortal among mathematicians, and the book stands as his monument.

Self-taught, Henri Chrétien displayed in his writing a keen regard for the practical. Working in a printing office at 12 years of age, with only elementary school education, he became acquainted with mathematical journals, and discovered that he had the gift of understanding mathematical formulas. He soon applied himself to the broad subject of astronomy. Then, because he wanted to realize improvements in instrument design which he felt could not be made without a serious theoretical background, he applied himself to the study of geometrical optics. By the outbreak of World War I, at the age of 35, he had earned a reputation as an authority on optical instruments. This unusual academic back-ground may explain why his teaching was so practical. Even today, with many books published on the subject, Chrétien's work is outstanding in the field of geometrical optics as a basic tool for the physicist who wants to design and compute an optical system.

The first part of the book is devoted to elementary basic ideas, which form the best background to geometrical aberrations ever written. The second part deals with the classical theory of third order aberrations, mainly influenced by the German school, and supported by references to English works. Even today, when we regard with pride the development of theories of aberrations of the fifth order, this part stays valuable. The precise notation is well chosen and simple. The consideration of coefficients of correction to take care of aspherisation of optical surfaces, and also the elementary manner of presentation, contributes to the value of this second part of the book. The third part is devoted to a general theory of aberrations. The works of Hamilton, Bruns, Schwarzschild, Sampson, Caratheodory, sometimes difficult to read in the original, are here much easier to grasp. After this much pure theory, the book returns to the practical. The two last parts deal with numerical computation and diffraction. A chapter covering advanced ray tracing deals with the methods of Seidel and Schwarzschild; and stands, even in these days of electrical computation, as the best approach to off-axis ray tracing. Another chapter sums up the methods of interpolation, shows how to determine empirical functions, and terminates with a method of computation introduced by Chrétien himself. By combining third order theory and ray tracing, he expresses a method for determining a set of coefficients of correction to represent the actual aberrations of a real system with the third order equations.

Some earlier editions of this book were printed in beautiful calligraphic script. Part of a page from the 2d ed., published in 1929, is reproduced herewith.—*Louis P. Raitiere*, General Precision Laboratory Inc., Pleasantville, N. Y.

et négativement pour les surfaces concaves.

Examinons tout d'abord l'effet d'une seule surface réfringente (M). Nous désignerons par U le point-objet S ou T, et par U' le point image, S' ou T'.

Posons (fig. 171):

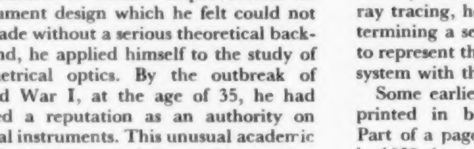
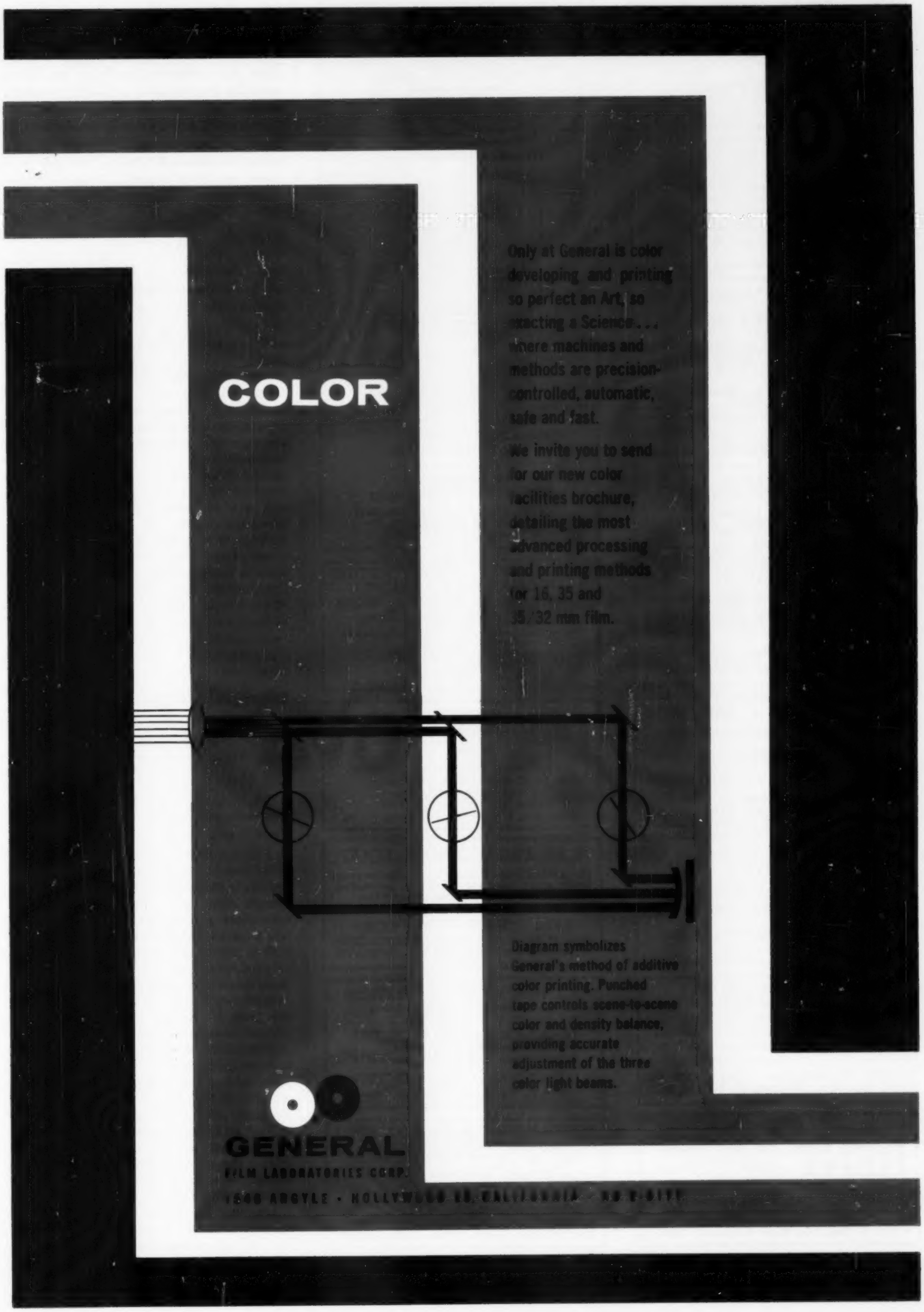


Fig. 171.

$MX = x$, $MP = p$, $JU = l$; l sera égal soit à $\underline{s}$, soit à $\underline{t}$, selon que nous considérerons l'image sagittale ou l'image tangentielle.

Écrivons les équations de l'imagerie astigmatique sous forme d'invariants:

$$(S) \quad \mathcal{Q}_s = \frac{n\cos j}{r_z} - \frac{n}{s} = \frac{n'\cos j'}{r_z} - \frac{n'}{s'},$$


COLOR
Only at General is color developing and printing so perfect an Art, so exacting a Science . . . where machines and methods are precision-controlled, automatic, safe and fast.
We invite you to send for our new color facilities brochure, detailing the most advanced processing and printing methods for 16, 35 and 35/32 mm film.
Diagram symbolizes General's method of additive color printing. Punched tape controls scene-to-scene color and density balance, providing accurate adjustment of the three color light beams.
GENERAL
FILM LABORATORIES CORP.
1546 ARGYLE

Closed-Circuit Television Systems: Color and Monochrome

Prepared by Government Service Department, RCA Service Co. Published (1959) by RCA Service Co. (Available from Educational Administrator, RCA, Bldg 15-2, Camden, N.J.) Three divisions are included in this one volume: Book I, "Monochrome Systems," 226 + xii pp. incl. index, table of contents, list of illus., list of tables; Book II, "Color Systems," 102 + v pp. incl. index, table of contents, list of illus., list of tables; Book III, "Addenda: Educational Television — Industrial Television." 19 + i pp. incl. index, table of contents, list of illus. 8½ by 11 in. Price $4.50.

This volume is a convenient source of information on many aspects of closed-circuit television applications, especially for management personnel responsible for the planning and for technical personnel responsible for the system engineering. Originally written under an Air Force contract as a guide for military personnel in the planning and application of closed-circuit television for military use, the information is equally useful in non-military situations. The information is presented simply and clearly and, in the descriptive sections, in nontechnical language. The Addenda contains brief descriptions of specific educational and industrial installations such as the Walter Reed Army Medical Center and the installation at the State University of Iowa.

Photographic Chemistry, Vol. I

By Pierre Glafkides. Tr. from 2d French ed. (1957) by Keith M. Hornsby, Fountain Press, London (1958). Distributed by The MacMillan Co., 60 Fifth Ave., New York 11 (1959). 491 + xiii pp. Charts, diagrams and tables. 6 by 9¾ in. Price $21.00

This is a British translation of about half of the second edition of Glafkides standard test book *Photographic Chemistry*. The second French edition has been in use for about two years and has proven very helpful, when used with discretion. The translation suffers the same defects as the French original, plus some poor proofreading and other minor inaccuracies.

However, in spite of these disadvantages the book is essentially a very useful one which covers the field more completely and in greater detail than do most books of its type. In particular this book contains a large section on photographic emulsions, starting with a chapter on gelatin as a raw material, and continuing with the preparation and handling of emulsions and of the base materials on which they are coated. This is the most complete coverage of this aspect of photographic chemistry that has been in print in English in many years.

On the debit side the main disadvantages are due to frequent generalizations drawn from specific cases which may be in themselves accurate reports of individual situations. In addition to this, work of a preliminary type is often reported with equal

emphasis to that given work resulting from many years of detailed study. The experienced user of the book unconsciously makes allowance for this, but students being introduced to the subject for the first time or newcomers to the photographic industry would have no way of knowing how much relative value to give to various portions.

In addition, although the French edition is dated 1957, there is a considerable amount of well documented published work on various aspects of photographic chemistry which has been omitted here. For instance, there is only a slight discussion of the use of ammonium thiosulfate as a fixing agent and a paper by D. B. Alnutt (*Jour.* Oct. 1943, pp. 300–328) is the only reference given on this subject. There is no mention of the newer hypo neutralizing solutions based upon the sea-water washing work of Crabtree's group at Kodak, and there is little mention of Phenidone, or of the contributions of Dr. Mitchell to photographic theory.

The book is well organized and the various sections fit together extremely well so that with the exceptions mentioned above the reader finds that his introduction to the various aspects is progressive and in a good order. The tabulations of the various types of photographic emulsions give an excellent picture of the interrelations between the various types and since most commercial emulsions are based upon more than one type or are even separate coatings of different emulsions upon the same base, it is well to know how they compare with each other.

The chapter on stablizing and finishing photographic emulsions is generally excellent although there are a few flaws such as the rather uncritical reporting of extensive experimental work with the various antifoggants and a few generalizations which are definitely incorrect; for example, Glafkides says (p. 383), "a photographic emulsion coated onto a gelatin treated base cannot stick perfectly without the use of a wetting agent." Wetting agents *are* used in all production departments, but small-scale test coatings do not need them.

In general then, this is an excellent text book marred by a number of flaws which will be easily recognized by the experienced user, but not by the student or newcomer to the field, for whom the book otherwise would have the most value. One of these flaws is careless use and spelling of names in references which would not prevent finding the references but might confuse those not familiar with the literature. For example on page 128 reference is made to U.S. Patent 2,596,978 as issued to Dillon and Searle. In fact, the patent was issued to Dillon and Burtner and assigned to the G. D. Searle Co., their employer.

Macmillan, who distribute the book in this country, tell us that the Volume II, promised for late 1959, is progressing well and should be ready in a few months. This portion covers color photography as well as sensitizing dyes and some fundamental chemistry for the student. A list of its contents is given in the current Vol. I, following the index.—*Thomas T. Hill*, Photographic Products, Atlantic Gelatin, Woburn, Mass.

Filmfacts, a weekly publication containing comments on, and evaluations of, current motion pictures is now in its second year of publication. During 1958 it covered 435 films, quoted from over 1100 reviews and printed more than 180 illustrations, according to an announcement issued by the publishers. The Editor is Ernest Parmentier. The address is P.O. Box 53, Village Station, 150 Christopher St., New York 14.

Problems in Technical Publication Management—A Preliminary Survey is a 22-page pamphlet containing 10 chapters dealing with various aspects of technical writing and publishing. Author and publisher is Roswell Ward who is well known as writer, consultant and executive in the specialized field of technical writing. First published as a series of articles appearing during 1958 in *Armed Forces Management*, the 10 chapters have been revised and illustrated. Although primarily directed to Technical Publication Managers, the subject matter includes a number of helpful hints to authors of technical papers, especially in the chapters on "Creative Imagination in Technical Publications," and "Streamlining Methods of Technical Writing." The booklet is available from Mr. Ward at Rockledge, Bantam, Conn. It is priced at $3.50.

Better Movies in Color, a 24-page Eastman Kodak publication has been revised from an earlier version to include the latest available information on cameras with built-in exposure meters. Planned for the "home moviemaker," the booklet contains illustrated, step-by-step instructions on the best use of Brownie Automatic and Kodak Cine Automatic Cameras. It is priced at 35 cents and is available from Kodak dealers.

section reports

The Dallas-Fort Worth Section met on September 24 at the Mercantile National Bank Auditorium in Dallas with an attendance of 40. Speakers were Gordon Tubbs of Eastman Kodak Co., who discussed the Eastman Color Negative Type 5250, and Jay Berry of Alexander Film Co., who discussed the 1959 International Film Festival.

Through the use of slides, Mr. Tubbs described the specifications of the new higher speed Eastman Color Negative Film Type 5250. Following the description of the film capabilities, Mr. Tubbs showed 35mm film sequences dramatically demonstrating the advantages of the new film. The wives and guests particularly enjoyed the footage of the Japanese Royal Wedding and the Ice Follies.

Mr. Berry described the importance of creative engineering in the production of good commercial films. He showed many of the winning entries in the "International Festival of Television Commercials and Theatre Advertising Films." Before each film was shown he described the techniques to be seen, the country in which the film was made and the category in which the prize was awarded. These films from Italy, France, England and the United States were extremely entertaining and presented many stimulating ideas.—Philip W. Wygant, *Secretary-Treasurer*, 6021 Plants Ave., Dallas 12, Texas.

The Hollywood Section had an attendance of 225 at its September 15 meeting at the National Broadcasting Co. in Hollywood. Oscar F. Wick and Ralph E. Lovell, both of NBC-Burbank, and Mel W. Smith, S&S Mfg. Co., Alta Loma, were the speakers. Mr. Wick discussed "Double System Editing of Color Video Tape." Mr. Lovell's subject was "An Electronic Leader Device for Video Tape Recording." Mr. Smith talked about "A Precision Video Tape Splicer of Unique Design."

Mr. Wick described, and illustrated by the use of slides, the double system editing of color video tapes by NBC-Burbank. This system involves the making of a separate magnetic soundtrack and a photographic kinescope recording simultaneously with the making of the video-tape recording. A common cueing system is employed which keeps these records in synchronism. The photographic kinescope single-system recording serves as a cutting work print. Its cues serve to permit the synchronous cutting of the magnetic soundtrack and the video-tape recording. After these two records have been cut, the soundtrack is dubbed from the separate sound record onto the video-tape recording to make a composite record. This technique overcomes the disadvantages of cutting single-system records in that the action does not have to be preplanned to allow a section where no dialog occurs to take care of the sound-picture separation.

Mr. Lovell described and demonstrated an electronic leader device to permit the recording of an "Academy" leader on the head end of video-tape records. This device, having a rear illuminated slate section for recording the production, scene and take numbers, also incorporates an electronically generated count-down device which forms Arabic digits that count down at 1-sec intervals to be photographed by the television camera to act as a cueing leader. In addition, audible signals were provided to cue the audio soundtrack.

Mr. Smith described a high-precision video-tape splicer which incorporated a number of unique features, such as a calibrated microscope, a special shearing action cutter and vernier tape-positioning rollers. The details of this splicer were shown graphically by color slides.—Robert C. Hufford, *Chairman*, Eastman Kodak Company, 6706 Santa Monica Blvd., Hollywood.

The New York Section met on September 15 at the Carnegie World Affairs Center with an attendance of 62. Paul Wittlig, Manager, Production Development, CBS-

TV, addressed the group. His subject was "Television Staging Devices."

Mr. Wittlig presented two motion pictures showing new staging devices designed and developed by the CBS Television Network to overcome the physical boundaries of studios. The major technique described was "Video Scene" which combines images from two electronic cameras to create artistic settings which normally would require a great deal of construction and expense. This method, which could be described as "electronic matting," makes use of synchronized camera operation. In addition, Mr. Wittlig described a technique called "photomat" which combined a small set and a photograph as well as the "mill pond" effect which makes use of a mirror image of the original scene to give the illusion of a reflection on water.

After the film and description of the techniques by Mr. Wittlig, a lively discussion period was held to give the audience an opportunity to ask specific questions concerning the various techniques.—Edward M. Warnecke, *Secretary-Treasurer*, Eastman Kodak Co., 342 Madison Ave., New York.

The Rochester Section met on October 1 at the Dryden Theatre with an attendance of 22. The program included a panel discussion entitled "Three Looks at Educational Television." Participants were: Paul L. Chamberlain, General Electric Co., Syracuse; Lloyd Kaiser, TV Consultant, Rochester Board of Education; and Miss Geraldine McMullen, Rochester Board of Education.

Mr. Chamberlain gave an excellent description of the present status of educational television using a market-research approach to the future of the medium. He discussed closed-circuit television vs. the aired signal and explained how the great needs of education may be met with educational television. He indicated that possible monetary savings might be realized in a consolidated school district.

Mr. Kaiser described the rather limited approach which Rochester has made in regard to its public school system. He discussed the problems relative to establishment of educational television from an economic and a professional standpoint. Miss McMullen described some of the programs in which she participated.

A 45-minute question and answer period followed the formal presentations.—R. E. Connor, *Secretary-Treasurer*, 35 Chatham Park, Rochester 18, N.Y.

The San Francisco Section met on July 14th, after cocktails and dinner at Hal's Restaurant, at the Eastman Kodak Processing Lab. in Palo Alto to hear two papers on color motion-picture film.

Vaughan C. Shaner, Motion Picture Film Dept., Eastman Kodak Co., guest speaker, discussed the new 35mm Color Negative Film Type 5250 and the 16mm Ektachrome Reversal Camera Film Type 7255.

In both discussions, a description of the

emulsion relating to ASA speed, color balance and grain structure was given before a comparison demonstration was shown. The 35mm ASA 50 was compared to the older ASA 25 film. The increased depth of field (due to being able to stop down one full stop) and the better color reproduction was very apparent. A question and answer period followed Mr. Shaner's formal presentation.

Coffee and donuts were served after the meeting.—Frank Mansfield, *Secretary-Treasurer*, 57 Stoneyford Ave., San Francisco 24.

The San Francisco Section met on August 11 at Palmer Films, Inc., with an attendance of 26. Bill Cothran, News Director, KROV-TV, San Francisco, and Charles Stanyan, Senior Cameraman, KRON-TV, were the speakers. Mr. Cothran discussed "News Coverage for Television." Mr. Stanyan explored the "Technical Problems of Newsreel Coverage."

Mr. Cothran gave a rundown of the operation of his department. Problems regarding the general coverage of local news pickup, laboratory skeds and editing were covered.

Mr. Stanyan pointed out the advantages of magnetic sound over optical. Because of the selflimiting properties of the magnetic strip it is possible for many one-man pickups. Since it is also possible to monitor off the track during recording, it is possible to hear any wow and flutter that may be introduced due to poor power regulation. This feature has saved many stories because a portable power supply could be brought into use.

Various samples of recent news subjects were projected, showing the high quality that is possible with magnetic sound.—Frank Mansfield, *Secretary-Treasurer*, 57 Stoneyford Ave., San Francisco 24.

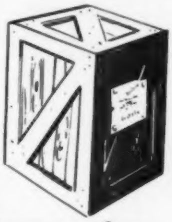
The San Francisco Section met on September 8 at San Francisco International Airport with an attendance of 58. Speakers were Norman Merkel, E. Mathews, and E. P. Sullivan, all of Federal Airways Agency. Subject of discussion was "Radar Control and Intercom System at San Francisco International Airport."

Following cocktails and dinner at the International Inn, Mr. Merkel, with the aid of color slides, gave a detailed explanation of the equipment used in the new radar control approach system and the intercom between the tower operators and the radar operators. This new intercom system has reduced the interval of landings from 7½ min per plane to 3 min and a departure time from 10 min to 2 min.

Mr. Mathews spoke on the electronic equipment and explained the method used for proper cancellation of stationary returns so that moving returns, such as aircraft, would allow for a better display for the radar operator.

After the lecture portion of the meeting the group moved to the San Francisco International Airport where they were taken to the radar room and control tower to see the equipment in operation.

The meeting concluded with a tour through American Airlines new 707 Jet Airliner, conducted by Ralph Weinals, chief communications maintenance man for American Airlines.—Frank Mansfield, *Secretary-Treasurer*, 57 Stoneyford Ave., San Francisco 24.



new products

(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

Zeiss Ikon Automatic Projection System

Abstracted and translated from "Vereinfachte Filmvorführung durch Einsatz von Automaten" by Dipl.-Ing. H. Tümmel in Kino-Technik, No. 10 (1958), pp. x-xii, xiv.

The Zeiss Ikon automatic projection system uses a special switch to trigger the various operations of a motion-picture program automatically. Each step, from the lowering of the house lights and the raising of the curtain, to the close of the final film, can be preset so that the entire program can run without supervision. Xenon lamps have been found preferable for this system since they require less attention during operation than carbon arcs.

The system comprises a drum-type switch and a drive system, mounted together and housed inside a closed box. The drum is grooved. Spring-held metal nodes can be affixed at appropriate points in the grooves. As the drum revolves the nodes strike against a rack of switches and activates the various pieces of equipment.

The drum, which makes one revolution in 4 min. is driven by an a-c motor. Its outer rim is marked with a time scale in 5-sec, to facilitate accurate placing of the nodes. There are 25 grooves on the drum, permitting the use of up to 25 nodes to perform the same number of switching actions. The first switch starts the motor, leaving 24 switches for operating the various elements of the projection and theater equipment involved. For unusually elaborate presentations it is possible to add a second rack of 24 switches below the first; additional nodes are then installed and adjusted in the grooves so as to miss one of the racks and activate the other.

Provision is made for the equipment to turn itself on and off as required. During the showing of a film, for example, the equipment will be switched off and automatically restarted when it is time to proceed to the next operation. Synchronization of the various parts of the program is achieved by a signal transmitted from a cue mark on the film or tape in the projector. Similarly, impulses are transmitted from the automatic switch to the projector, sound system, lighting controls or other elements of the theater equipment. Only minor modifications of this equipment are required.

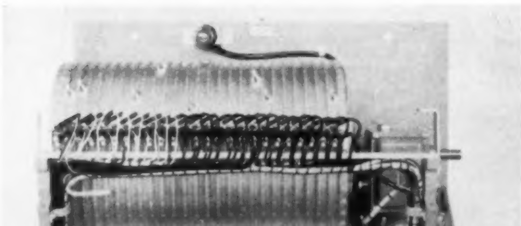
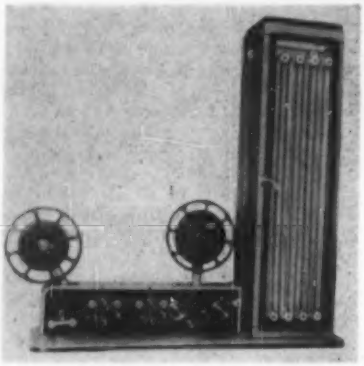


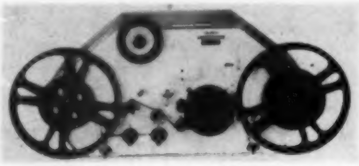
Fig. 1. Automatic drive switch and drive with housing removed.

Fig. 2. Detail of drum showing the spring-held metal nodes.

Approval of a new ASA Standard for exposure indexes is expected as a consequence of continued recommendations to amateur and professional photographers to use higher than published ASA exposure indexes, according to information from Eastman Kodak Co., Rochester 4, N. Y. In releasing the information company spokesmen said, "It is our understanding that when the new Standard is issued, it will reduce but not eliminate the safety factor currently involved. Under the present Standard the index, by definition, is considered as $2\frac{1}{2}$ times the minimum exposure required for an excellent print. This gives a safety factor of $1\frac{1}{3}$ stops or $2\frac{1}{2}$ times."

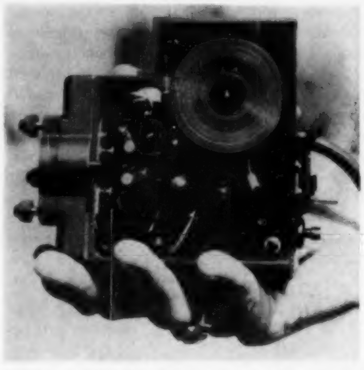


Two magnetic film striping machines were introduced by S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19, at the SMPTE Convention (Fall 1959) in New York. One machine, the Sosound Peterson, employs a bead-type applicator. Two stripes may be applied simultaneously. The oxide mixture wells have interchangeable application discs with micrometer adjustment of layer thickness. After passing through the enclosed drybox, an adjustable polisher imparts a high gloss. Said to operate at about 2200 ft/hr, the price of the machine ranges under $3000.



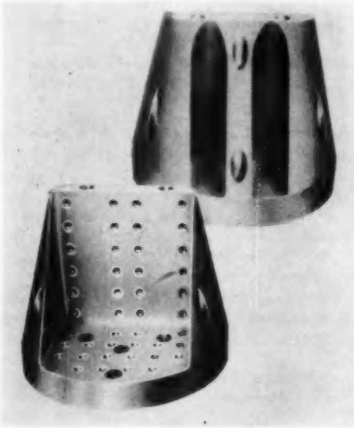
The Sosound Cinemaphon laminates the stripe with a special cement which is bonded to the film as it passes over a heated drying drum. This type of machine is priced under $2000. Both machines lay a full soundtrack or halftrack and a balance stripe. Both techniques, beading and laminating, are said to be permanent and unaffected by conventional black-and-white developing and fixing baths.

A miniature 16mm camera called the Traid 15 has been announced by Traid Corp., 17136 Ventura Blvd., Encino, Calif. Designed especially for missile and aircraft applications, the camera is also suited to other situations requiring compactness and versatility. Dimensions are $5\frac{3}{16}$ by $2\frac{13}{16}$ by $4\frac{7}{16}$ in., and weight is $2\frac{3}{4}$ lb. The camera is equipped with variable



shutter, magazine heater, 2-v d-c motor and is adapted for interchangeable preloaded 50-ft magazines and GSAP or "C" lens mounts. It is available with any single speed of 16-, 64- or 100-frames/sec and has double-tooth sprockets for high G loading. It is priced at $1296.

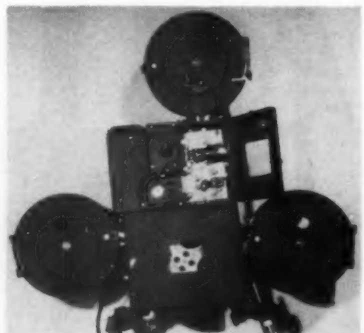
Fisher Microphone Booms, Stands and Crab Perambulators are available on a rental basis from Camera Equipment Co., 315 W. 43 St., New York 36. The equipment is manufactured by J. L. Fisher of N. Hollywood, represented by Cinequipment of Hollywood. Rental (per day) for the equipment is: Boom, $8.50; Stand, $4.00; Crab Perambulator, $11.00. The microphone boom is designed for light weight and maneuverability. The maximum extended reach is 16 ft and the microphone can be rotated through 360°.



A T-type environmental test fixture made of cast magnesium has been designed by the Avco Research and Advanced Development Division, 201 Lowell St., Wilmington, Mass., for resonant-free testing during normal use and for mounting test specimens during vibration, shock and acceleration tests. It is designed to permit simultaneous testing of specimens on three mutually perpendicular axes. Called the Multi-Purpose Environmental Test Fixture, it is available in a small size used with a 1500 g-pound exciter and a larger size for use with a 5000 g-pound exciter. The smaller size has a dimensional capacity of 6 by 6 by $4\frac{1}{2}$ in. with a weight capacity of up to 6 lb. The larger type has a dimensional capacity of 12 by 12 by $9\frac{1}{2}$ in. and weighs up to 25 lb.

Oscar and Boscar are the names of two types of record readers designed to expedite the analysis of various oscillograph-type trace records appearing either on film or paper. Most models of the Oscar family may be equipped with projection units allowing analysis of records on 16mm to 89mm film. The Boscar is a reading device designed primarily to analyze data appearing on frame-by-frame film. These and other special purpose readers used to convert information recorded in pictorial or graphic form into either digital or proportional analog resistance form, products of Benson-Lehner Corp., 11930 West Olympic Blvd., Los Angeles 64, are described in a catalog available from the company.

A power-driven cradle head designed to tilt and pan TV cameras by remote control is a product of Houston Fearless Corp., 11827 W. Olympic Blvd., Los Angeles 64. The cradle head is powered by two separate motors, contained in soundproof housings, which tilt the camera 30° up and 38° down and rotate 370°. The remote control panel can be installed at any convenient location. The cradle head can also be operated by hand. It is designed to accommodate monochrome TV studio cameras and vidicon color cameras.



A 35mm projector, Model 2810PL3, has been added to the DeVry line produced by Paromel Electronics Corp., 3956 W. Belmont Ave., Chicago 18. Designed for simultaneous projection of 35mm picture work print and separate 35mm sound optical work print, it is recommended as a preview model for TV film programs. Film capacity is said to be equivalent to a half-hour TV program. The feed reel for the picture portion is mounted at the top of the projector in the conventional way, and the take-up magazine is located at the front. The optical sound portion has the feed reel mounted at the back of the projector and the take-up is located in the modified lower section.

A small oscilloscope called the Panelscope Model P1B7X2 designed to view color or black-and-white TV sync pulses has been announced by Waterman Products Co., 2445 Emerald St., Philadelphia 25. A built-in selector switch allows selection of one of three negative going TV sync signals to be viewed at sweep rates of one-half either line or frame frequencies. Another selector position permits connection of an external calibrating signal to the vertical amplifier. The overall panel dimensions are $5\frac{3}{16}$ in. high and $5\frac{1}{4}$ in. wide. The instrument extends 10 in. beyond the mounting panel.

A nine-pin miniature beam deflection tube specifically designed for balanced-modulator, balanced-mixer, and product-detector service in single-sideband communications equipment has been introduced by the RCA Electron Tube Division. The deflection system of the tube makes it suitable for use in low-distortion audio-fader circuits, remote switching of studio and high-fidelity equipment, and other applications in which isolation of control voltage and signal voltage is required. It is capable of operation to about 100 mc. This tube, RCA-7360, has two plates and two beam-deflecting electrodes, together with a screen grid, control grid and cathode. The total beam current is determined by the screen-grid and control-grid voltages, while the portion of the total beam current collected by each plate is determined by the voltage difference between the deflecting electrodes. Each plate current, therefore, is a function of the product of two input voltages.

A polycrystalline ceramic which has the property of transmitting light has been announced by General Electric Research Laboratory, Schenectady, N. Y. The new material, called Lucalox, is said to remain stable at temperatures close to 3600 F. The light-transmitting quality is achieved by removing the microscopic small pores, or "bubbles," that are normally found in ceramic materials. Suggested applications include high-intensity incandescent and discharge lamps and banks of infrared lamps that are used to test the heat-resistance of missile nose-cones and other space-vehicle equipment.

A new high-speed color film, the Eastman Color Reversal Film, Daylight Type, SO-260 has been announced by Eastman Kodak Co., Rochester 4, N. Y. The film is reported to have a normal exposure rating of 160. A companion, tungsten-balanced film, Eastman Color Reversal Film, Type B, SO-270, has a normal index of 125. The new film is said to combine exceptional speed with adequate sharpness, moderate grain pattern and good color reproduction, permitting photography under a wide variety of natural and artificial lighting conditions. Both films are

available in 16mm and 35mm sizes. The films may be purchased from the W. J. German Co. of Fort Lee, N. J.

Eleven professional motion-picture films available from the Gevaert Company of America, Inc., Cine Dept., 321 W. 54 St., New York 19, are described in a folder giving technical data such as exposure information, footage numbering and other details. The folder is available upon request to the company.

Organizational activities of Bonded Services Division of Industrial Enterprises, Inc., of New York, resulting from a recent (September) merger are directed toward consolidating the firms various service functions, company officials have announced. Storage activities have been centralized under a new department called Bonded Film Storage. The 35mm exchange activities are handled by a department called Bonded Film Distributers and TV film distribution will be handled by a department called Bonded TV Film Service.

Prestoseal Manufacturing Corp., of Long Island City, N. Y., has announced expansion of the company's manufacturing plant. The new facilities are adjacent to the company's present quarters and will double the available space.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Cameraman—Motion, Still, Aerial. 7 yrs experience, Navy and civilian school graduate. Experienced in aerial, still, data gathering and motion-picture production photography and equipment. Employed by major aircraft corporation and Cape Canaveral Missile Test Range. Past membership in American Society of Photogrammetry, Active Member of SMPTE. Single, age 27, will relocate. Prefer position as photog. coordinator or motion-picture cameraman with large corporation. 1808 Tower Rd., Glen Burnie, Md.

Representative. Wanted: to represent equipment manufacturer or other in capacity of public relations and trouble shooter, calling on industrial, TV producers etc. 35 yrs experience camera work, projection and reinstating alienated clients. Centrally located in Syracuse for travel in East. R. Rees Lumley, 339 South Warren St., Syracuse 2, N.Y.

Film Production. Talented production executive desires relocation in N.Y.C. area. Experienced in all phases of motion-picture production, particularly industrial, documentary and public relations films. Resume and references supplied on request. Write: Les Miller, Rm 707, 276 Fifth Ave., New York 1. MU 9–1771.

Film Production. Assignment wanted for travel film, news, documentary or educational film. Have three B&H cameras, wide-angle lens to 400 mm, one special camera for slow motion, motor driven, also still cameras and tape recorder. Have shot recent TV series and bird life film for national studio. Made over fifty trips through Central America and six through most of Europe. Will accept assignments to any area. F. Robert Johnston, 278 East 23 St., Costa Mesa, Calif.

Film Salesman-Project Supervisor. Expand your business—rare opportunity to acquire creative man with diversified experience in film promotion, production, distribution. Ivy League grad, 33, personable. Excellent refs. Write: EO, Suite M 18, 314 East 38 St., New York 16.

Motion Picture Laboratory Specialist. Well versed in equipment and procedures. Desires position with a well established organization. For resume write: Charles Stephens, 772 Miami Chapel Rd., Dayton, Ohio.

Director, Cameraman, Editor of nontheatrical films. Experienced in all phases of film production. Was employed by Audio Visual Service USOM/L, c/o American Embassy in Beirut, Lebanon as Program Advisor, Film Production Supervisor. Age 26, married, member of SMPTE, willing to relocate. Resume on request. Write: Hrayr Toukhanian, 3731 Irving St., San Francisco 22.

Motion-Picture Production and Direction. Former Secretary-Treasurer SMPTE Student Chapter CCNY, trained in all phases motion-picture production and directing, desires position with production company with possibility of working up through editing and camera to direction. Age 29, single, willing to relocate. Robert F. de Brito, 120 East 31 St., New York 16. MU 5-3060.

Positions Available

Photographic Specialist. Require professional for executing photographic assignments in creative application of all available photographic techniques and equipment. Applicant must interpret requirements of those using photo lab facilities. Direct and photograph motion pictures and stills. Direct the work of other photographers and technicians. Send resume to: W. O. Borden, Employment Office, Convair-Astronautics, Cocoa, Fla.

Engineers, Mechanical & Electronic. Experienced in design, production, manufacture of photographic consumer and/or military products and instrumentation. Must be familiar with motion-picture camera and projector design; capable of creative simple design solutions for economical production manufacture; knowledge of dimensioning for parts interchangeability. Opportunity to join reputable engineering staff of progressive, rapidly growing organization. Foto Development Corp., 123 Eileen Way, Syosset, L.I., N.Y.

Designer. Expanding manufacturer needs designer with experience in motion-picture laboratory equipment. Write or call Forway Corp., 245 West 55 St., New York 19. CO 5–0372.

Cinematographer-Editor. Small organization in Chicago area requires capable industrial cameraman for work in 16mm color, combining editing and some still work for sound slidefilms. Man selected must have good college background, married, under 35. Recent grads with good college background in motion picture-TV or cinematography will also be considered. Good income with excellent opportunities for advancement. Please furnish references, salary requirement and qualifications. Address P.O. Box 244, Park Ridge, Ill.

Optical Effects. Exceptional opportunity for responsible young married man (25–35) to embark on motion-picture film career with leading optical effects house. Good health and basic knowledge of still photography required. If you know a career minded ambitious young man who can accept challenging work have him contact Eastern Effects, Inc., 333 West 52nd St. New York 19. CIrcle 5–5280.

Electrical Engineer. Manufacturers of instrumentation cameras currently engaged in enlarging their facilities are looking for a mechanical engineer experienced in the design of motion-picture cameras, optical printers, or related equipment. Write or call for an appointment. Photo-Sonics, Inc., 2704 W. Olive Ave., Burbank, Calif. Attn: Otto Schiff—VIctoria 9–3144.

Engineers—Optical, Video Circuitry, TV Systems with training and experience to assume broad project responsibility. These openings afford opportunity to work in advanced mobile and airborne TV areas where individual contributions can range from conceptual realization to proof of feasibility. Please write informally, in complete confidence to: Mr. Joseph Skelly, Box 12, DuMont Research & Development Division, 750 Bloomfield Ave., Clifton, N.J.

Technical Writers. Electronic equipment; familiarity with military specs and government procedure essential. Work in Long Island area. 12 required. **Electronic Engineers,** with TV camera, monitor, closed-circuit design experience. 15 required. Penult Corp., 103-14 Roosevelt Ave., Corona 68, N. Y. HIckory 6-1294.

Photographic Instrumentation Engineer. GS-13, $10,130 per yr. To act as technical rep. of U. S. Army Pictorial Center, N.Y., in working with manufacturers and reps. of other gov. agencies on testing, operation repair, design and supervision of manufacture of electromechanical instrumentation systems based on photographic recording devices. Considerable travel involved. Applicants must have 4 yr engineering college or equivalent college and experience combination, plus 3 yr general and 1 yr specialized engineering experience. Standard Form 57 (Application for Federal Employment), obtainable from the U. S. Civil Service Commission or any Post Office, should be completed and sent to: Civilian Personnel Office, Army Pictorial Center, 35-11 35th Ave., Long Island City 1, N.Y. RA 6-2000, Ext. 238.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Meeting Calendar

American Rocket Society, Annual Meeting, Nov. 16–20, Sheraton-Park Hotel, Washington, D.C.
International Automation Exposition and Congress, Nov. 16–20, New York Trade Show Bldg., New York.
ASME, Annual Meeting, Nov. 29–Dec. 4, Chalfonte-Haddon Hall, Atlantic City, N.J.
American Association for Advancement of Science, Annual Meeting, Dec. 26–31, Chicago.
Sixth National Symposium on Reliability and Quality Control, Jan. 11–13, 1960, Statler Hilton Hotel, Washington, D.C.
Institute of the Aeronautical Sciences, Annual Meeting, Jan. 25–28, 1960, Hotel Astor, New York.
AIEE, Winter General Meeting, Jan. 31–Feb. 5, New York.
IRE and AIEE, Transistor and Solid State Circuits Conference, Feb. 11–12, 1960, Univ. of Penn., Philadelphia.
National Society of Professional Engineers, Winter Meeting, Feb. 18–20, 1960, Broadview Hotel, Wichita, Kan.
National Electrical Industries Show, Mar. 6–9, 1960, Coliseum, New York.
ASCE, New Orleans Convention, Mar. 7–11, 1960, Jung Hotel, New Orleans, La.
IRE National Convention, Mar. 21–24, 1960, Coliseum and Waldorf-Astoria Hotel, New York.
American Chemical Society, National Meeting, Apr. 5–14, 1960, Cleveland, Ohio.
Optical Society of America, Spring Meeting, Apr. 7–9, 1960, Hotel Statler, Washington, D.C.
Inter-Society Color Council, 29th Annual Meeting, Apr. 11, 12, 1960, Philadelphia Museum College of Art, Philadelphia.
IRE, South West Regional Conference and Electronics Show, Apr. 20–22, 1960, Shamrock-Hilton Hotel, Houston, Texas.
IRE, National Aeronautical Electronics Conference, May 2–4, 1960, Dayton, Ohio.
87th Semiannual Convention of the SMPTE, including Equipment Exhibit, May 1–7, 1960, Ambassador Hotel, Los Angeles.
IRE National Aeronautical Electronics Conference, May 2–4, 1960, Dayton, Ohio.
Society of Military Engineers, National Convention, May 16, 17, 1960, Washington, D.C.
ASME, Design Engineering Div. Conference, May 23, 1960, New York.
Design Engineering Show, May 23–26, 1960, Coliseum, New York.
Institute of the Aeronautical Sciences, National Summer Meeting, Mid-June, 1960, Los Angeles.
Acoustical Society of America, Spring Meeting, June 9–11, 1960, Providence, R.I.
National Society of Professional Engineers, Annual Meeting, June 9–11, 1960, Statler Hotel, Boston, Mass.
AIEE, Summer General Meeting, June 19–24, 1960, Atlantic City, N.J.
American Society for Engineering Education, Annual Meeting, June 20–24, 1960, Purdue Univ., West Lafayette, Ind.
Fifth International High-Speed Congress and Equipment Exhibit, sponsored by the SMPTE, Oct. 16–22, 1960, Sheraton-Park Hotel, Washington, D.C.
89th Semiannual Convention of the SMPTE, May 1–5, 1961, Royal York, Toronto.
90th Semiannual Convention of the SMPTE, Oct. 2–6, 1961, Lake Placid, N. Y.
91st Semiannual Convention of the SMPTE, Apr. 30–May 4, 1962, Ambassador Hotel, Los Angeles.
92d Semiannual Convention of the SMPTE, Oct. 22–26, 1962, Drake Hotel, Chicago.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April 1959 Journal.

sustaining members

of the Society of Motion Picture and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

Progress toward the attainment of these objectives is greatly aided by the financial support provided by the member companies listed below.

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National Carbon Company, A Division of Union Carbide and Carbon Corporation
National Screen Service Corporation
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Neumade Products Corporation
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Warren Conrad Portman Company
Precision Laboratories (Division of Precision Cine Equipment Corporation)
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The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee, Byron Roudabush, c/o Byron Motion Pictures, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.